

THE MEDICAL JOURNAL OF AUSTRALIA

VOL. II.—28TH YEAR. SYDNEY, SATURDAY, SEPTEMBER 6, 1941.

No. 10.

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THE EFFECT OF EXERCISE IN HOT ATMOSPHERES UPON THE SALT-WATER BALANCE OF HUMAN SUBJECTS.

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THE investigations reported here were made at the same time as the observations upon the pulse rate reported previously in this journal.⁽¹⁾ Like them, they form part of an experimental inquiry carried out under the auspices of the National Health and Medical Research Council.⁽²⁾ The conditions of the experiments were fully described in the previous communication. In brief, subjects were introduced into a room in which the desired hot atmosphere had been produced and were kept there for seven hours. During this time marching or lifting exercise was performed. Two atmospheres were used: "hot wet" (dry bulb 87.5° F., wet bulb 83.5° F.), with a relative humidity of 87% and an effective temperature of 83° F.; and "hot dry" (dry bulb 101° F., wet bulb 79° F.), with a relative humidity of 38% and an effective temperature of 84.5° F. (The highest average effective temperature found in Queensland and the Northern Territory during the working day in the hottest month of the year is 84.1° F. This may, of course, be exceeded at the height of the day or for longer periods during "heat waves".) Three different levels of water administration were tried, and water

administration was also compared with the administration of saline solution. Frequent administration was compared with the administration of the same total amount at longer intervals.

Methods of Investigation.

The subject was weighed immediately upon entering the room and again at suitable intervals thereafter, upon a Sauter balance weighing to half a gramme. The quantities of fluid administered, the weight of food eaten and the volume of urine voided were recorded. From these figures the amount of moisture lost as sweat could be calculated. (Under these conditions the rate of insensible evaporation from the lungs is relatively unimportant.) If it is assumed that the water content of the body is 65% of its weight, these figures also provide a measure of variation in the general degree of bodily hydration against which can be compared the variation in hydration of the circulating blood. This latter figure was obtained by measuring the refractive index of serum from centrifuged samples of blood, collected in narrow glass tubes from finger punctures and allowed to clot. From this the serum protein content was estimated according to the data of Neuhausen and Bloch.⁽³⁾ This method has met with some criticism; but in our hands, with standard technique, it has proved sufficiently reliable for these purposes.

The specific gravity of the urine was measured with a microhydrometer and its content of sodium chloride was estimated by electrometric titration according to the method of Best.⁽⁴⁾ At the end of the fourth and again at the end of the seventh hour the subject stripped off his woollen pants, socks and gloves into a tub and washed himself down thoroughly into the same tub with about five litres of rain-water. These washings were collected and the clothes rinsed in them thoroughly; the volume was measured (including the water taken up by the clothes, as shown by their increase in weight) and an aliquot

was analysed by the electrometric method for its chloride content. In this way the chloride loss in the sweat was estimated. Check washings of the subject's skin and check soakings of the clothes showed no appreciable error from these sources.

From the specific gravity of the urine the concentration of total solid was estimated by the use of Long's coefficient of 2.66. Recent investigations⁽¹⁰⁾ suggest another figure, but also show that little variation occurs on ordinary diets in the specific gravity "pattern". As our work is comparative we have felt justified in continuing the use of the older and better known coefficient. From figures thus obtained and the chloride estimations mentioned above the concentration of non-chloride solids can be estimated.

Effects upon Sweat and Sweating.

Evidence presented by different workers regarding the effect of various factors upon the volume of sweat produced and its chloride content is conflicting.⁽¹⁰⁾ The following considerations relate to comparisons of experimental sets identical in composition except for the variable being studied. The rate of sweating, the concentration of chloride (expressed as sodium chloride), and the consequent rate of chloride loss are studied.

Acclimatization.

Some subjects completed the same experiment upon two occasions, two in the hot wet and four in the hot dry atmosphere, with different degrees of acclimatization. A comparison of their reactions upon the two occasions reveals no constant effect of acclimatization upon the rate of sweat loss during marching exercise or recovery therefrom, or upon the concentration of chloride or its rate of loss in the sweat.

Rate of Water Administration.

In Table I are set out the average figures obtained in the different experimental sets. The references quoted below in parentheses are to this table. Four sets of experiments illustrate the comparative effects of different rates of water administration: (i) hot wet atmosphere, marching (Ia, Ib, Ic); (ii) hot wet atmosphere, lifting (Id-6, Ie-6, and If-4, If); (iii) hot dry atmosphere, marching (Ig-6,

Ih-6, Ih-6); (iv) hot dry atmosphere, lifting (Ij, Ik-5, Il-5). A comparison of the figures shows that in the hot dry atmosphere the sweat volume is increased by an increase in the amount of water taken by mouth; but in the hot wet atmosphere the rise produced by moderate amounts of water is not increased by further administration. In nearly all cases the chloride concentration in the sweat is reduced by an increase in water administration. The effect upon the loss of chloride in the sweat is irregular, as it is determined by the balance of effect between the first two factors.

Administration of Saline Solution as compared with Water.

The administration of saline solution and that of water are compared by four sets of experiments: (i) hot wet atmosphere, quarter-hourly administration (IIa, IIb); (ii) hot dry atmosphere, quarter-hourly administration (IIc-7, IIj-7); (iii) hot wet atmosphere, two-hourly administration (IIo-6, IId-6); hot dry atmosphere, two-hourly administration (IIg-6, IIh). Marching was the exercise in each set. The difference is not pronounced in the hot wet atmosphere, but in the hot dry atmosphere the administration of saline solution is accompanied in both cases by a reduction of sweat volume and of chloride concentration, with a pronounced consequent reduction in chloride loss.

Frequency of Fluid Administration.

Four experimental sets are concerned in the frequency of fluid administration: (i) hot wet atmosphere, administration of water (IIa, IIc-6); (ii) hot dry atmosphere, administration of water (IIe-6a, IIg-6); (iii) hot wet atmosphere, administration of saline solution (IIb, IId-6); hot dry atmosphere, administration of saline solution (IIf-6a, IIh). The differences are not large and must be regarded as inconclusive.

Hot Wet as compared with Hot Dry Atmosphere.

The two atmospheres used here were selected as having fairly similar effective temperatures—that is, they have been found to cause the same general feelings of discomfort and to have the same general effect upon many bodily functions.⁽¹²⁾ We⁽¹²⁾ found these two atmospheres to

TABLE Ia.
Effects upon Sweat and Sweating: Marching.

Experiment Number.	Atmosphere.	Fluid Administered.	Rate of Administration. (Cubic Centimetres/ Minutes.)	Number of Subjects.	Rate of Sweat Loss. (Grammes per Hour.)			Total Sweat Loss. (Cubic Centimetres.)	Sweat.				
					First Exercise. (2-3.)	Recovery. (4.)	Second Exercise. (6-7.)		Concentration of Sodium Chloride. (Milligrammes per 100 Cubic Centimetres.)		Sodium Chloride Loss. (Milligrammes.)		
									A.M. (1-4.)	P.M. (5-7.)	A.M. (1-4.)	P.M. (5-7.)	Total.
Ia	Wet.	NH.	—	5	219	58	206	1,119	52	48	312	277	589
Ib	Wet.	Water.	40/15	5	227	57	273	1,175	46	51	289	327	616
Ic	Wet.	Water.	80/15	5	216	97	230	1,096	35	41	222	251	473
Id	Dry.	NH.	—	5	397	238	397	2,055	61	84	792	888	1,680
Ie	Dry.	Water.	60/15	5	393	212	397	2,014	61	85	787	886	1,653
If	Dry.	Water.	120/15	5	411	202	435	2,171	60	79	705	925	1,630
Ig	Dry.	Water.	60/15	5	412	201	435	2,171	66	77	779	909	1,688
Ih	Dry.	Water.	120/15	5	445	229	471	2,409	58	72	751	990	1,741
Ii	Dry.	Water.	60/15	5	435	224	475	2,395	55	66	706	911	1,617
IJa	Wet.	Saline solution.	40/15	6	194	50	229	1,013	49	52	274	315	589
IJb	Wet.	Water.	320/120	5a	186	66	193	967	55	47	256	258	514
IJc	Wet.	Saline solution.	320/120	6	202	71	232	1,109	55	47	311	311	622
IJe	Wet.	Saline solution.	320/120	6a	208	47	243	1,046	56	52	318	308	626
IJf	Dry.	Water.	60/15	6	176	43	207	884	54	53	253	258	511
IJg	Dry.	Water.	60/15	6	447	194	441	2,290	78	80	1,038	944	1,982
IJh	Dry.	Water.	60/15	6a	413	201	430	2,163	73	78	895	866	1,761
IJi	Dry.	Water.	60/15	7	440	201	451	2,298	75	79	975	952	1,927
IJj	Dry.	Saline solution.	60/15	6	415	181	425	2,173	60	74	755	847	1,602
IJk	Dry.	Saline solution.	60/15	6a	386	190	414	2,074	56	73	639	801	1,440
IJl	Dry.	Water.	480/120	7	410	189	430	2,178	59	75	740	864	1,604
IJm	Dry.	Water.	480/120	5	395	211	415	2,114	70	80	789	910	1,699
IJn	Dry.	Saline solution.	480/120	6	392	213	421	2,123	71	80	799	922	1,721
IJo	Dry.	Saline solution.	480/120	6	345	194	419	1,963	60	72	597	807	1,404

^a Numbers in parentheses indicate hours of exposure.

TABLE IB.
Effects upon Sweat and Sweating: Lifting.

Experiment Number.	Atmosphere.	Fluid Administered.	Rate of Administration. (Cubic Centimetres/Minutes.)	Number of Subjects.	Rate of Sweat Loss. (Grammes per Hour.)					Total Sweat Loss. (Cubic Centimetres.)	Sweat.				
					First Pre-exercise. (2.)	First Exercise and Recovery. (3.)	Rest. (4.)	Second Pre-exercise. (6.)	Second Exercise and Recovery. (7.)		Sodium Chloride Concentration (Milligrammes per 100 Cubic Centimetres.)		Sodium Chloride Loss. (Milligrammes.)		Total.
											A.M. (1-4.)	P.M. (5-7.)	A.M. (1-4.)	P.M. (5-7.)	
Id	Wet.	Nil.	—	5	81	131	55	46	158	554	55	57	164	160	324
Ie	Wet.	Water.	40/15	4	76	129	54	44	149	541	58	58	178	156	334
If	Wet.	Water.	80/15	4	59	138	65	60	198	672	51	54	175	163	338
Ij	Dry.	Nil.	—	5	55	143	56	57	180	627	55	58	188	198	386
Ik	Dry.	Water.	60/15	4	63	133	108	73	185	707	37	37	142	171	313
Il	Dry.	Water.	120/15	5	174	301	187	191	324	1,445	45	66	387	464	851
				5	173	310	207	233	367	1,633	43	60	383	505	888
				6	162	302	203	223	364	1,576	45	62	377	507	884
				4	159	340	232	241	361	1,712	44	46	406	404	809
				5	168	334	227	240	382	1,712	45	50	410	445	855

¹ Numbers in parentheses indicate hours of exposure.

have the same effect upon pulse rate when ample water was administered. Sweating, however, constitutes an exception to this general similarity of effect.¹⁰

Ten experimental sets establish the difference for the conditions studied here: (i) marching, administration of moderate amounts of water every quarter of an hour (IIa, IIe-6); (ii) marching, administration of moderate amounts of saline solution every quarter of an hour (IIb, II-f-6); (iii) marching, administration of moderate amounts of water every two hours (IIo-5a, IIg-5); (iv) marching, administration of moderate amounts of saline solution every two hours (II-d-6a, IIh); (v) marching, no fluid administration (Ia, Ig-5); (vi) marching, administration of moderate amounts of water every quarter of an hour (Ib, Ih-5); (vii) marching, ample water administration every quarter of an hour (Ic, Ii-5); (viii) lifting, no fluid administration (Id-5, Ij); (ix) lifting, administration of moderate amounts of water every quarter of an hour (Ie-6, Ik-6); (x) lifting, ample water administration every quarter of an hour (If, II-4). In all cases the sweat volume in the hot dry atmosphere, as compared with the hot wet atmosphere, is increased from two to three times, while the chloride concentration is also definitely increased in most instances. The exceptions to this latter increase occur in experiments involving lifting exercise. As a result of these increases the total loss of chloride in the sweat is increased from three to four times in the hot dry atmosphere as compared with the hot wet atmosphere.

Range of Values.

Experiments in which an ample supply of water was given at intervals of a quarter of an hour should provide the range of normal values for our subjects. The maximum, minimum and average values are as shown in Table II.

TABLE II.

Atmosphere.	Rate of Sweat Loss at Rest. (Cubic Centimetres per Hour.)	Rate of Sweat Loss During Marching. (Cubic Centimetres per Hour.)	Concentration of Sodium Chloride in Sweat. (Milligrammes per 100 Cubic Centimetres.)
Hot wet:			
Maximum ..	200	394	52
Minimum ..	23	153	27
Average ..	90	223	37
Hot dry:			
Maximum ..	329	626	106
Minimum ..	103	346	31
Average ..	217	455	54

Correlation of Volume and Chloride Concentration.

A scatter diagram revealed that while the increased rate of sweating in the hot dry atmospheres was accompanied by an increased chloride concentration, there was no general correlation of this nature. In most subgroups the correlation, if any, tends to be in the reverse direction—that is, under given atmospheric conditions the concentration of chloride tends to fall with increased sweat production.

Extra Sweating of Exercise.

If the preexercise rates of sweating ascertained in the lifting experiments are compared with the exercise rates in the corresponding marching series, the extra sweating induced by marching in these atmospheres can be determined. The results are shown in Table III.

TABLE III.

Number of Experiment.	Average Pre-exercise Sweating. (Cubic centimetres per Hour.)	Average Exercise Sweating. (Cubic Centimetres per Hour.)	Average Extra Sweating During Exercise. (Cubic Centimetres per Hour.)
Hot wet atmosphere:			
Ia-d	63	213	150
Ib-e	53	250	197
Ic-f	68	238	170
Hot dry atmosphere:			
Ig-j	183	397	214
Ih-k	193	424	231
Ii-l	204	455	251

It will be seen that while the extra sweating called forth in the hot wet atmosphere is somewhat less than that in the hot dry atmosphere, it is greater in proportion to the rate of sweating at rest.

Afternoon Reactions as compared with Morning Reactions.

It will be seen from Table I that almost without exception the average rate of sweat loss during the afternoon exercise is greater than that during the morning exercise. Preexercise sweating rates show the same afternoon excess. The chloride concentration is likewise greater in the afternoon on nearly all occasions.

Effects upon Bodily Hydration.

Certain observations made in earlier experiments^{11,12} suggested that comparisons should be made between the

hydration changes in the body as a whole and the variations in the water content of the blood stream. The concentration of serum protein is, for reasons given in the same reports, used as an index of the latter condition.

Acclimatization.

There is, in some cases, some suggestion that the water content both of the body as a whole and of the blood stream is kept at a higher level when acclimatization has had an opportunity to develop; but this finding is not constant, and in one case at least it is reversed.

Rate of Water Administration.

The data relating to this and subsequent paragraphs are given in Table IV. The same experimental sets call for study as those used in the consideration of sweating. The names and references will not be repeated. It will be seen that increasing the amount of water administered increases the general body hydration in all cases, the additional water being largely retained. In the experiments involving marching the concentration of serum protein is also reduced by an increase in the amount of water administered. In lifting experiments in the wet

atmosphere there is in each case a little reduction of serum protein concentration; but in the dry atmosphere the reduction obtained by the giving of moderate amounts of water is not further increased by the giving of ample water.

Administration of Saline Solution as compared with Water.

In all cases when saline solution is being administered the general water content of the body is maintained at a higher level and the concentration of serum protein stays at a lower level. These differences naturally do not appear until the latter half of the period.

Frequency of Fluid Administration.

In hot wet atmospheres, while in the interval between delayed administrations the general bodily hydration falls below that in the control series, it is restored or even raised to a higher level after the administration. In hot dry atmospheres it is not restored to the level of the control series. The effects upon the serum protein content are somewhat irregular and do not run parallel with general bodily hydration.

TABLE IVA.
Effects upon Bodily Hydration: Marching.

Experiment Number.	Atmosphere.	Fluid.	Rate of Administration. (Cubic Centimetres/Minutes.)	Number of Subjects.	Body Water. (Percentage of Initial.)					Serum Protein. (Percentage of Initial.)						
					First Pre-exercise. (1.) ¹	First Exercise. (3.)	Recovery. (4.)	Second Pre-exercise. (5.)	Second Exercise. (7.)	(1.)	(2.)	(3.)	(4.)	(5.)	(6.)	(7.)
Ia	Wet.	NIL.	—	5	99.6	98.0	97.8	99.0	97.3	100	96	99	101	101	99	99
Ib	Wet.	Water.	40/15	5	100.0	99.2	99.5	101.3	99.9	99	99	98	97	97	97	97
Ic	Wet.	Water.	80/15	5	100.4	100.4	101.0	102.7	101.3	98	94	94	93	93	92	91
Id	Dry.	NIL.	—	5	99.2	96.3	95.8	97.1	94.2	102	102	103	106	106	104	108
Ie	Dry.	Water.	60/15	5	99.3	96.5	96.0	97.2	94.4	101	103	104	106	106	105	109
Ih	Dry.	Water.	60/15	5	100.1	98.6	98.8	100.4	99.0	100	100	101	98	99	99	—
Ii	Dry.	Water.	120/15	5	100.1	98.5	98.6	100.4	98.8	99	99	100	99	99	98	—
Ij	Dry.	Water.	120/15	5	100.3	99.5	99.9	102.1	99.9	94	93	95	94	94	93	94
Ila	Wet.	Water.	40/15	6	100.3	99.6	99.9	102.2	100.1	96	95	96	95	95	94	94
Ilb	Wet.	Saline solution.	40/15	6	100.1	99.4	99.7	101.7	100.1	99	98	97	98	98	96	97
Ild	Wet.	Water.	320/120	5a	99.8	99.3	99.9	101.7	100.2	100	99	97	96	98	98	96
Ile	Wet.	Water.	320/120	6	99.6	99.1	99.7	101.4	99.8	100	99	98	97	97	99	96
Ilf	Wet.	Saline solution.	320/120	6	99.8	99.1	99.8	101.7	100.7	99	98	97	96	96	96	95
Ilg	Dry.	Water.	60/15	6a	99.8	99.3	100.0	101.9	101.2	99	97	96	95	95	96	94
Ih	Dry.	Water.	60/15	6	100.0	98.3	98.3	99.8	98.1	100	100	100	100	100	101	100
Ii	Dry.	Water.	60/15	6a	100.0	98.5	98.5	100.2	98.5	98	97	97	96	96	96	96
Ij	Dry.	Saline solution.	60/15	7	100.0	98.4	98.3	99.9	98.1	99	98	98	99	99	99	99
Ika	Dry.	Saline solution.	60/15	6	100.0	98.4	98.5	100.0	98.8	100	100	101	100	99	99	99
Ikb	Dry.	Saline solution.	60/15	6a	100.1	98.7	98.8	100.4	99.2	99	99	101	100	99	99	97
Ikc	Dry.	Saline solution.	60/15	7	100.0	98.5	98.6	100.1	98.9	99	99	101	100	99	99	98
Ild	Dry.	Saline solution.	60/15	6	99.7	98.0	98.4	99.0	98.0	101	101	100	103	103	103	102
Ile	Dry.	Saline solution.	60/15	6	99.7	98.1	98.5	99.3	98.2	100	100	100	102	102	102	101
Ilf	Dry.	Saline solution.	60/15	6	99.7	98.4	98.8	100.5	98.9	99	99	98	98	99	98	97

¹ Numbers in parentheses indicate hours of exposure.

TABLE IVb.
Effects upon Bodily Hydration: Lifting.

Experiment Number.	Atmosphere.	Fluid.	Rate of Administration. (Cubic Centimetres/Minutes.)	Number of Subjects.	Body Water. (Percentage of Initial.)					Serum Protein. (Percentage of Initial.)						
					First Pre-exercise. (1.) ¹	First Exercise. (3.)	Recovery. (4.)	Second Pre-exercise. (5.)	Second Exercise. (7.)	(1.)	(2.)	(3.)	(4.)	(5.)	(6.)	(7.)
Ia	Wet.	NIL.	—	5	99.6	98.9	98.6	99.5	98.9	99	98	98	99	99	99	101
Ib	Wet.	Water.	40/15	6	99.6	98.9	98.6	99.5	98.9	99	97	98	99	99	98	100
Ic	Wet.	Water.	40/15	4	100.2	100.1	100.3	101.4	100.9	99	98	98	97	97	96	96
Id	Wet.	Water.	80/15	6	100.2	100.1	100.2	101.5	101.1	99	99	99	98	97	97	98
Ie	Dry.	NIL.	—	5	98.7	97.6	97.1	97.3	96.0	102	102	103	104	104	104	106
If	Dry.	Water.	60/15	5	100.0	99.5	99.6	101.2	100.6	100	100	99	98	98	98	99
Ig	Dry.	Water.	60/15	6	100.0	99.6	99.6	101.3	100.7	100	100	99	99	98	98	99
Ih	Dry.	Water.	120/15	4	100.8	100.4	100.8	102.1	101.3	102	101	102	101	99	98	98
Ii	Dry.	Water.	120/15	5	101.0	100.7	100.9	102.4	101.6	101	100	101	101	100	99	99

¹ Numbers in parentheses indicate hours of exposure.

Hot Wet Atmospheres as compared with Hot Dry Atmospheres.

In all cases the general bodily hydration falls to a lower level in the hot dry atmosphere than in the hot wet atmosphere. The serum protein concentration shows a corresponding rise, but one which in some cases is not so pronounced.

Range of Values.

Experiments in which, apart from lunch, no fluid was administered during exposure to the hot dry atmosphere, provide the maximum demands made upon bodily hydration. The maximum individual dehydration experienced at the end of the day in these trials was to 92.1% of the total bodily water, the minimum to 95.6%. The maximum serum protein concentration was to 116% of the initial value; but one subject in this experiment showed no rise beyond 102% of the initial values.

If the figures of Tables I and IV are compared, it will be seen that surplus water was eliminated in the urine only when the general body hydration would have reached 102% or more of its initial values. There is no indication that the body had any difficulty in retaining the water given to replace sweat losses. The excess of blood hydration shown by the serum protein concentration bears no relation to the degree of general hydration.

The amount of water given was barely sufficient to replace sweating in the marching experiment in hot wet atmospheres, and insufficient by 500 cubic centimetres in the marching experiments in hot dry atmospheres. On the whole, however, "moderate" water administration proved equivalent to water replacement, and "ample" from one and a half times to twice water replacement.

Correlation between General Bodily Hydration and Serum Protein Concentration.

When no fluid is given in the hot dry atmosphere the serum protein has a concentration equal to or slightly in excess of that in the body generally. But when fluid is given at frequent intervals in the hot dry atmosphere, and at all times in the hot wet atmosphere, the serum protein enjoys a greater dilution than would be expected on the basis of the average change in body water content. If a scatter diagram (Figure 1) is compiled from the final values of Table IV, these points will be clearly seen. It will also be observed that marching exercise experiments with fluid replacement are accompanied by a greater degree of serum protein dilution than lifting exercise experiments with their decreased work periods. Previous observations⁽¹⁰⁾ in conjunction with these would suggest that the correlation curve is sigmoid, the upper limb becoming progressively steeper as the degree and rate of dehydration are increased.

Effects upon Urinary Excretion of Water and Chlorides.

There has been much discussion upon the ability of the body to retain water administered during severe sweating. It would appear to be established that to replace large amounts of fluid lost by sweating, the addition of salt is also necessary; but the effect of such additions during lesser degrees of sweating is not clear. Previous observations⁽¹⁰⁾ at higher temperatures have suggested that a chloride-saving mechanism operates in renal excretion during sweating. These points are examined here by a consideration of the rate of urinary water loss, the concentration of chloride (calculated as sodium chloride) in the urine, the rate of urinary chloride loss, the rate of loss of non-chloride solids in the urine, and the ratio of chloride to non-chloride solids in the urine.

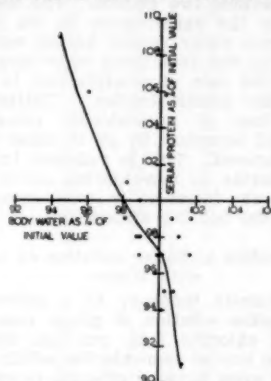


FIG. 1. RELATION OF CHANGES IN SERUM PROTEIN CONTENT TO CHANGES IN BODY WATER CONTENT (AVERAGE VALUES AFTER 7 HOURS HEATING UNDER DIFFERENT CONDITIONS).

Acclimatization.

In Table V are given those items which show an effect of acclimatization. It will be seen that in five out of six cases there is a reduction in the concentration of chloride in the urine, and in five a reduction in the rate of chloride loss. No definite changes were seen in the urine volume, while the rate of loss of non-chloride solids in the urine appeared to have quite a random association with acclimatization.

Rate of Water Administration.

The data relating to the rate of water administration and dealt with in subsequent paragraphs are set out in

TABLE V.
Effect of Acclimatization upon Urinary Water and Chloride Excretion.

Atmosphere.	Subject Number.	Experiment Number.	Day of Acclimatization.	Concentration of Sodium Chloride in Urine. (Grammes per 100 Cubic Centimetres.)								Rate of Urinary Sodium Chloride Loss. (Milligrammes per Hour.)							
				(0). ¹	(1.)	(2.)	(3.)	(4.)	(5.)	(6.)	(7.)	(0.)	(1.)	(2.)	(3.)	(4.)	(5.)	(6.)	(7.)
Wet.	A1	Ib	17	0.52	1.17	1.24	1.33	1.27	1.27	0.95	0.95	133	1,247	549	782	392	392	298	298
		Ila	6	1.04	1.23	1.33	1.48	1.38	1.38	1.38	1.37	457	1,714	880	991	710	710	541	541
	B1	Ib	19	1.44	1.54	1.39	1.36	1.33	1.11	0.49	0.74	782	765	697	583	288	287	517	729
		Ila	8	0.97	1.07	0.49	0.63	0.80	0.75	0.14	0.44	1,002	996	913	538	191	211	509	553
Dry.	A1	Ia	11	0.75	0.90	0.90	1.13	1.19	1.19	1.14	1.14	302	244	244	61	418	418	244	244
		Ila	1	1.07	1.49	1.49	1.63	1.63	1.47	1.47	1.47	301	564	564	250	250	488	488	488
	A2	Ia	15	0.57	0.30	0.94	0.81	0.71	0.75	0.75	0.77	110	346	685	438	238	276	276	347
		Ila	3	0.60	1.27	0.65	1.45	1.48	1.41	1.41	1.41	395	1,062	439	1,014	658	432	940	613
	B1	Ia	13	1.12	1.06	1.17	1.35	1.36	1.15	0.98	1.29	412	416	455	511	288	182	333	571
		Ila	3	1.61	1.66	1.64	1.61	1.60	1.46	1.06	1.31	620	772	633	570	294	281	339	458
	B4	Ia	5	1.57	1.55	1.51	1.53	1.55	1.17	0.91	1.31	308	483	321	210	174	132	132	219
		Ila	17	0.70	1.30	1.26	1.49	1.54	1.20	0.47	0.59	445	670	730	380	340	221	151	140

¹ Numbers in parentheses indicate hours of exposure.

Table VI. The same experimental sets call for consideration here as before, except that for a few experiments not all the data are available. It will be seen that the supply of water is followed by definite increases in urinary volume in the hot wet room, but that in the hot dry room pronounced increases in volume do not occur until "ample" water is given. There is a definite reduction in the chloride concentration of the urine in all cases when ample water is given and with lifting exercise in the hot wet room when moderate amounts of water are given. With marching in the hot wet atmosphere and lifting in the hot dry atmosphere a slight reduction occurs when a moderate amount of water is given. In general, therefore, the greater the increase in urinary volume, the greater the reduction of chloride concentration. The rate of chloride loss in the urine is determined by the combined action of the previous two factors. The net result is an increased loss in the experiments in the hot wet room and with moderate water supply during marching in the hot dry room. In the remaining experiments in the hot dry atmosphere the rate of chloride loss is unaffected by the rate of water administration. Unlike that of the chlorides, the loss of non-chloride urinary solids is increased upon all occasions by an increase in the amount of water administered. This is reflected in the fact that the ratio of chloride to non-chloride solids in the urine is reduced by an increase in the amount of water administered in the hot dry atmosphere.

Administration of Saline Solution as compared with Water.

There is a definite tendency to a reduction of urine volume when saline solution is given, some tendency to a reduction of chloride loss, and an indication of a reduction in the loss of non-chloride solids. There is no consistent effect upon urinary chloride concentration.

Frequency of Fluid Administration.

A delay in the administration of fluid tends to be accompanied by a reduced urine volume, reduced chloride loss and reduced ratio of chlorides to non-chlorides in the urine. The effect upon the chloride concentration is variable.

Hot Wet Atmosphere as compared with Hot Dry Atmosphere.

There is a reduction of urine volume in most experiments in the hot dry atmosphere as compared with the hot wet atmosphere; but this is to be expected, as the fluid administration did not maintain the same absolute relationship to sweat loss. With this goes a concentration of chloride in most, but not all, cases. In spite of this, however, the total loss of chlorides in the urine is never greater in the hot dry atmosphere, but on the contrary is less in nearly all cases. There is evidence of a corresponding reduction in the loss of non-chloride solids also, with no constant changes in the chloride/non-chloride ratio. The saving mechanism would not appear, therefore, to act specifically towards chloride.

Range of Values.

When the fluid being given by mouth does not replace the total water lost, the rate of water excretion falls progressively to the fourth or fifth hour. After that there is a rise, due no doubt to the effects of the fluid contents of the lunch taken during the fourth hour. Under the most dehydrating conditions studied the minimum average rate of water excretion obtained was 23 cubic centimetres per hour. At this point individual values varied from 9.0 to 39.0 cubic centimetres per hour. It is not an extremely low rate.⁶⁰ When more fluid is given than is required to replace fluid lost, the volume rises to a maximum in the sixth hour; this point is dictated partly by the steadily accumulating excess, partly by the extra lunch fluid. The chloride concentration in the urine shows similar but inverse diurnal changes. The relative variations throughout the day are of more importance in this connexion than are the absolute amounts, which are greatly influenced by the behaviour of the

chloride balance over the preceding few days. The maximum average concentration reached in all experimental sets was 1.48 grammes per 100 cubic centimetres; at this point the range of individual values was from 1.05 to 1.64 grammes per 100 cubic centimetres.

In practically all cases with marching exercise, the rate of chloride loss in the urine tends to fall to a minimum in the fourth to sixth hour with a subsequent rise. With lifting exercise this tendency is less pronounced. Something of a similar tendency can be seen in the case of the excretion of non-chloride solids with marching exercise, but not with lifting exercise. It tends in the case of non-chloride solids to be more apparent when insufficient fluid or none at all is administered.

The ratio of chloride to non-chloride solids in the urine behaves in an irregular fashion during the early hours of exposure, but from the second or third hour it generally falls. This fall may continue throughout the period or may reach a minimum in the fifth or sixth hour, from which a tendency to rise is frequently found.

Correlation between Bodily Hydration and Rate of Urine Water Loss.

In Figure II is given a scatter diagram showing the relationship of general bodily hydration to the rate of urinary water loss. The correlation is fairly close,

especially if points belonging to only the one period of the day are examined at the one time. The curve for different periods shifts first to the left, then to the right, during the day. The curve is hyperbolic in form, with a sharp inflection lying between 98.5% and 99.5% of the initial hydration. Above this range the urine volume increases rapidly from 45 cubic centimetres per hour; below this range the volume falls but slowly from 30 cubic centimetres per hour. A degree of hydration above 102% of the initial value will not be attained, except perhaps transiently by a sudden swamping. The lower limit of urinary volume lies a little below 10 cubic centimetres per hour,⁶⁰ a level not reached in this series.

A scatter diagram showing the relationship between serum protein concentration in terms of the initial value and the rate of urinary loss showed only a very general correlation, the relationship being especially loose when the serum protein becomes more dilute.

Correlation between Behaviour of Urinary Solids and Urinary Water Loss.

It is quite apparent from Table VI that on any one day the urinary chloride concentration behaves generally in an inverse fashion to the rate of urinary water loss; but that this is not the only factor is evident from the figures relating to the rate of chloride loss. Here there appears to be a diurnal change unrelated to water output. This may be due to a truly diurnal factor or to the effect of continuous exposure to a hot atmosphere. The former would be indicated by figures previously obtained upon subjects in a room at normal temperature.⁶⁰ The rate of loss of chloride is not consistently affected by the rate of water loss.

This diurnal change is still detectable in the rate of loss of solids other than chloride, but to a much smaller extent. The rate of loss of non-chloride solids is increased when the rate of urinary water loss rises.

Discussion.

A summary of our knowledge of factors affecting the rate of sweating and composition of sweat has been given

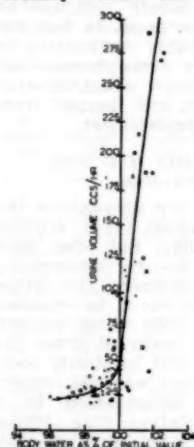


FIG. 2. RELATIONSHIP OF URINARY VOLUME TO BODILY HYDRATION (AVERAGE VALUES AT DIFFERENT STAGES OF HEATING UNDER DIFFERENT CONDITIONS)

TABLE VIIA.
Effects upon Urinary Water and Chloride Excretion.
Average Rate of Urine Water Loss. (Cubic Centimetres per Hour.)

Experiment Number.	Atmosphere.	Fluid Administered.	Rate of Administration. (Cubic Centimetres/ Minutes.)	Number of Subjects.	Hours of Exposure.								Total Urine Loss. (Cubic Centimetres.)
					0	1	2	3	4	5	6	7	
A. Marching.													
Ia	Wet.	Nil.	—	5	66	61	45	38	32	28	35	37	276
Ib	Wet.	Water.	40/15	5	43	64	50	60	43	73	127	92	509
Ic	Wet.	Water.	80/15	5	56	86	112	169	93	216	443	210	1,329
Ig	Dry.	Nil.	—	5	95	127	40	36	23	22	25	33	306
				5	84	111	39	35	23	24	25	33	290
Ih	Dry.	Water.	60/15	5	28	50	40	30	28	28	29	33	238
				6	30	50	44	35	29	30	33	38	259
Ii	Dry.	Water.	120/15	5	76	117	134	113	113	111	301	228	1,117
				6	68	104	117	98	101	98	267	201	986
Ila	Wet.	Water.	40/15	6	63	80	79	74	44	58	290	137	762
Ilb	Wet.	Saline solution.	40/15	6	76	67	78	76	66	59	189	102	637
Ile	Wet.	Water.	320/120	5a	44	49	50	47	27	73	224	158	628
				6	40	48	49	49	26	64	189	139	564
Ild	Wet.	Saline solution.	320/120	6a	41	45	44	38	28	34	47	56	292
				6	39	42	42	37	29	33	44	54	281
Ile	Dry.	Water.	60/15	6a	64	55	55	52	34	41	55	46	338
				7	59	53	53	47	32	39	52	44	320
IIf	Dry.	Saline solution.	60/15	6	38	41	41	35	26	28	36	38	245
				6a	49	40	36	33	24	27	36	42	238
				7	50	45	41	34	25	27	35	38	245
IIfg	Dry.	Water.	480/120	5	31	38	38	41	24	31	37	40	249
				6	32	37	41	41	31	45	36	39	270
IIfa	Dry.	Saline solution.	480/120	6	49	54	45	35	20	25	31	39	249

B. Lifting.

Ia	Wet.	Nil.	—	5	79	50	30	36	40	23	23	21	223
Ib	Wet.	Water.	40/15	6	73	44	28	36	38	26	24	23	219
Ic	Wet.	Water.	40/15	6	51	58	59	62	96	62	202	117	746
Ie	Dry.	Nil.	—	5	61	107	25	20	24	31	28	28	263
Ih	Dry.	Water.	60/15	5	46	58	43	31	24	42	87	68	353
Ii	Dry.	Water.	60/15	6	41	53	40	29	23	39	78	62	324
Ij	Dry.	Water.	120/15	5	56	95	107	133	188	227	439	314	1,503

TABLE VIIb.
Effects upon Urinary Water and Chloride Excretion.
Average Concentration of Sodium Chloride in Urine. (Grammes per 100 Cubic Centimetres.)

Experiment Number.	Atmosphere.	Fluid Administered.	Rate of Administration. (Cubic Centimetres/ Minutes.)	Number of Subjects.	Hours of Exposure.							
					0	1	2	3	4	5	6	7
A. Marching.												
Ia	Wet.	Nil.	—	5	0.80	1.12	1.13	1.21	1.16	1.02	0.91	0.88
Ib	Wet.	Water.	40/15	5	0.94	1.13	1.23	1.22	1.15	0.96	0.65	0.68
Ic	Wet.	Water.	80/15	5	0.59	0.98	0.63	0.60	0.74	0.32	0.10	0.39
Ig	Dry.	Nil.	—	5	0.61	0.90	1.11	1.15	1.16	1.09	0.93	1.06
				6	0.73	1.03	1.18	1.21	1.23	1.16	1.06	1.12
Ih	Dry.	Water.	60/15	5	1.00	0.96	1.10	1.16	1.16	1.05	0.95	1.10
				6	1.05	1.04	1.15	1.21	1.20	1.11	1.02	1.16
Ii	Dry.	Water.	120/15	5	0.63	0.85	0.59	0.46	0.35	0.35	0.16	0.28
				6	0.57	0.95	0.68	0.60	0.52	0.52	0.35	0.42
Ila	Wet.	Water.	40/15	6	0.93	1.23	1.13	1.06	0.96	0.84	0.35	0.62
Ilb	Wet.	Saline solution.	40/15	6	0.90	1.20	1.11	0.88	0.87	0.98	0.50	0.80
Ile	Wet.	Water.	320/120	5a	1.17	1.37	1.31	1.21	1.24	0.72	0.35	0.45
				6	1.21	1.40	1.35	1.29	1.29	0.85	0.55	0.60
Ild	Wet.	Saline solution.	320/120	6a	1.03	1.26	1.13	1.22	1.15	1.08	0.98	0.95
				6	1.04	1.32	1.20	1.31	1.25	1.14	1.07	1.02
Ile	Dry.	Water.	60/15	6	0.87	1.18	1.05	1.22	1.24	1.14	0.89	1.01
				7	0.90	1.22	1.11	1.28	1.29	1.19	0.98	1.07
IIf	Dry.	Saline solution.	60/15	6	1.25	1.36	1.40	1.50	1.37	1.19	1.18	1.55
				6a	1.33	1.38	1.35	1.41	1.42	1.26	1.18	1.45
				7	1.24	1.33	1.35	1.44	1.34	1.20	1.12	1.48
Ilg	Dry.	Water.	480/120	5	1.12	1.22	1.20	1.23	1.20	1.12	1.00	1.06
				6	1.08	1.19	1.16	1.18	1.16	1.08	0.94	1.00
IIf	Dry.	Saline solution.	480/120	6	0.97	0.95	1.03	1.10	1.10	0.91	0.84	0.95

B. Lifting.

Ia	Wet.	Nil.	—	5	0.54	1.08	1.10	1.05	1.09	1.06	0.84	0.84
Ib	Wet.	Water.	40/15	6	0.68	1.09	1.10	1.08	1.12	1.10	0.90	0.91
Ic	Wet.	Water.	40/15	6	0.98	1.14	0.95	0.77	0.50	0.60	0.19	0.33
Ie	Dry.	Nil.	—	5	0.95	1.19	1.31	1.26	1.29	1.27	1.15	1.07
Ih	Dry.	Water.	60/15	5	0.87	1.16	1.01	1.09	1.08	1.10	—	—
Ii	Dry.	Water.	60/15	6	0.85	1.18	1.04	1.09	1.09	1.12	—	—
Ij	Dry.	Water.	120/15	5	0.87	1.07	0.86	0.36	0.19	0.15	0.06	0.11

TABLE VIC.

Effects upon Urinary Water and Chloride Excretion.
Average Rate of Urine Sodium Chloride Loss. (Milligrammes per Hour.)

Experiment Number.	Atmosphere.	Fluid Administered.	Rate of Administration. (Cubic Centimetres/Minutes.)	Number of Subjects.	Hours of Exposure.								Total Sodium Chloride Loss (Milligrammes.)
					0	1	2	3	4	5	6	7	
A. Marching.													
Ia	Wet.	Nil.	—	5	443	553	475	429	314	253	293	325	2,642
Ib	Wet.	Water.	40/15	5	381	709	586	598	361	447	452	530	3,683
Ic	Wet.	Water.	80/15	5	292	820	659	677	460	376	439	595	4,026
Ig	Dry.	Nil.	—	5	416	1,039	402	386	254	237	248	366	2,932
				6	416	951	414	401	270	280	266	385	2,967
Ih	Dry.	Water.	60/15	5	301	372	415	318	298	276	271	350	2,300
				6	346	433	498	412	335	333	350	445	2,806
Ii	Dry.	Water.	120/15	5	334	937	598	363	302	296	374	345	3,215
				6	294	867	568	347	344	309	524	401	3,360
IIa	Wet.	Water.	40/15	6	491	890	712	688	406	432	527	598	4,253
IIb	Wet.	Saline solution.	40/15	6	476	790	848	513	391	537	578	759	4,416
IIc	Wet.	Water.	320/120	6a	445	654	662	554	310	367	455	537	3,539
				6	408	659	666	625	301	348	422	552	3,573
IId	Wet.	Saline solution.	320/120	6a	435	572	467	468	282	329	451	511	3,080
				6	418	559	462	485	308	336	455	513	3,118
IIe	Dry.	Water.	60/15	6a	466	637	528	573	392	394	471	463	3,458
				7	456	626	533	527	372	408	475	466	3,407
IIf	Dry.	Saline solution.	60/15	6	453	542	567	523	348	357	450	605	3,392
				6a	628	524	477	468	334	351	451	625	3,230
				7	594	575	548	497	326	334	420	570	3,270
IIg	Dry.	Water.	480/120	5	401	545	548	611	334	389	449	522	3,398
				6	385	511	540	571	382	489	405	469	3,367
IIh	Dry.	Saline solution.	480/120	6	511	557	504	441	252	293	331	463	2,841

B. Lifting.

Ia	Wet.	Nil.	—	5	406	487	326	387	433	241	198	194	2,266
Ib	Wet.	Water.	40/15	6	430	438	303	383	423	280	221	235	2,283
Ic	Wet.	Water.	80/15	6	456	645	508	381	340	349	421	291	2,935
Ij	Dry.	Nil.	—	5	456	927	323	243	275	355	307	286	2,716
Ik	Dry.	Water.	60/15	5	356	615	342	333	257	485	—	—	—
				6	323	575	335	315	251	453	—	—	—
Il	Dry.	Water.	120/15	5	338	762	622	348	260	343	276	292	2,903

TABLE VID.

Effects upon Urinary Water and Chloride Excretion.
Average Rate of Urine Loss of Non-Chloride Solids. (Grammes per Hour.)

Experiment Number.	Atmosphere.	Fluid Administered.	Rate of Administration. (Cubic Centimetres/Minutes.)	Number of Subjects.	Hours of Exposure.								Total Non-Chloride Solids Loss. (Grammes.)
					0	1	2	3	4	5	6	7	
A. Marching.													
Ia	Wet.	Nil.	—	5	1.27	2.27	1.93	1.75	1.56	1.37	1.67	2.06	12.61
Ib	Wet.	Water.	40/15	5	1.55	2.84	1.95	2.43	1.59	2.26	2.71	2.62	16.40
Ic	Wet.	Water.	80/15	5	1.85	3.34	2.75	2.60	1.93	3.36	4.36	2.03	20.37
Ig	Dry.	Nil.	—	5	1.53	2.89	1.43	1.48	1.13	1.21	1.37	1.95	11.46
				6	1.56	2.37	1.50	1.56	1.18	1.37	1.42	2.08	11.48
Ih	Dry.	Water.	60/15	5	1.24	1.86	1.95	1.33	1.52	1.58	1.56	1.83	11.63
				6	1.48	2.02	2.17	1.70	1.66	1.76	1.72	2.03	13.06
Ii	Dry.	Water.	120/15	5	1.52	3.28	3.03	1.97	2.16	2.07	2.31	1.75	16.57
				6	1.35	3.14	2.92	1.86	2.27	2.05	2.99	1.86	17.09
Ila	Wet.	Water.	40/15	6	2.10	2.37	2.49	2.18	1.73	2.20	3.47	2.87	17.31
Ilb	Wet.	Saline solution.	40/15	6	1.79	2.28	2.57	2.48	1.41	2.35	3.30	3.74	17.13
Ild	Wet.	Water.	320/120	6	1.95	2.22	2.37	2.05	1.53	1.80	2.47	3.17	15.61
Ile	Dry.	Saline solution.	320/120	7	1.50	2.02	1.97	1.82	1.38	1.82	2.39	2.24	13.64
Ilf	Dry.	Water.	60/15	6	1.65	1.72	1.85	1.61	1.27	1.51	1.90	2.00	11.86
		Saline solution.	60/15	7	2.08	1.88	1.87	1.60	1.23	1.49	1.93	2.07	12.07
B. Lifting.													
Ia	Wet.	Nil.	—	5	1.16	1.86	1.47	1.57	1.77	1.35	1.38	1.36	10.76
				6	1.31	1.74	1.41	1.66	1.77	1.51	1.48	1.51	11.08
Ib	Wet.	Water.	40/15	6	1.84	2.39	2.06	1.77	1.78	1.83	2.63	1.95	14.46
Ij	Dry.	Nil.	—	5	1.40	2.30	1.20	1.00	1.03	1.32	1.26	1.39	9.50
Ik	Dry.	Water.	60/15	5	1.62	2.44	1.77	1.60	1.30	2.11	—	—	—
				6	1.55	2.32	1.73	1.57	1.30	2.03	—	—	—
Il	Dry.	Water.	120/15	5	1.57	2.98	2.30	1.64	1.62	3.21	4.79	2.72	19.26

TABLE VII.
Effects upon Urinary Water and Chloride Excretion.
Average Ratio of Sodium Chloride/Non-Chloride Solids.

Experiment Number.	Atmosphere.	Fluid Administered.	Rate of Administration. (Cubic Centimetres/ Minutes.)	Number of Subjects.	Hours of Exposure.							
					0	1	2	3	4	5	6	7
A. Marching.												
Ia	Wet.	Nil.	—	5	45	27	25	26	24	21	17	15
Ib	Wet.	Water.	40/15	5	23	27	27	25	24	21	18	20
Ic	Wet.	Water.	80/15	5	20	25	36	28	26	16	12	30
Ig	Dry.	Nil.	—	5	31	29	29	26	23	20	18	19
Ih	Dry.	Water.	60/15	5	24	20	19	24	21	21	19	19
Ii	Dry.	Water.	120/15	5	23	21	21	24	22	22	21	21
Iia	Wet.	Water.	40/15	6	25	25	21	20	18	15	20	21
Iib	Wet.	Saline solution.	40/15	6	33	35	33	29	25	24	31	22
Iic	Wet.	Water.	320/120	6	25	29	26	25	21	18	17	16
Iid	Wet.	Saline solution.	320/120	6	21	26	21	25	22	20	19	18
Iie	Dry.	Water.	60/15	7	30	31	28	31	30	25	20	21
Iif	Dry.	Saline solution.	60/15	6	30	31	30	33	26	24	23	29
				7	30	30	29	32	25	22	21	27
B. Lifting.												
Id	Wet.	Nil.	—	5	42	27	23	24	21	19	15	15
Ie	Wet.	Water.	40/15	6	39	25	22	23	21	19	15	16
Ij	Dry.	Nil.	—	5	29	27	24	24	19	18	17	17
Ik	Dry.	Water.	60/15	5	22	25	20	20	21	22	—	—
				6	20	25	20	20	20	22	—	—
Il	Dry.	Water.	120/15	5	24	26	26	22	19	15	20	18

elsewhere.⁴⁰ On many of the points our knowledge was incomplete or the evidence was conflicting. More definite statements are possible as a result of these experiments. The rate in our subjects was increased: (i) by an increase in the rate of water administration in the hot dry atmosphere from "nil" to "ample"; (ii) by the substitution of a hot dry atmosphere for a hot wet atmosphere of the same effective temperature; (iii) by the undertaking of exercise; (iv) in the afternoon. The rate was decreased by the administration of saline solution instead of water in the hot dry atmosphere. The rate was not consistently affected by acclimatization or by the substitution of larger amounts of fluid given infrequently for smaller amounts of fluid given frequently.

The chloride concentration in the sweat is much lower in our (Queensland) subjects than in English subjects previously studied.⁴⁰ This was checked by putting two of our subjects under exactly the same conditions as the English subjects and estimating the chloride loss in exactly the same way. It was reduced by: (i) an increase in the rate of water administration, (ii) the administration of saline solution instead of water in the hot dry atmosphere. It was increased: (i) by the substitution of a hot dry atmosphere for a hot wet atmosphere of the same effective temperature; (ii) in the afternoon. It was not consistently affected by acclimatization, by the frequency of fluid administration or by the rate of sweating.

The rate of chloride loss in the sweat was noticeably increased in the afternoon as compared with the morning of a working day, and by the substitution of a hot dry atmosphere for a hot wet atmosphere of the same effective temperature; it was noticeably decreased by the administration of saline solution instead of water; it was not consistently affected by other factors.

With the atmospheres and types of exercise used here the general bodily hydration can be maintained or raised to 102% of the initial value on successive days over a period of three weeks without special attention to the chloride intake. The urine volume, however, commences to rise sharply at levels of bodily hydration below 100%, suggesting some tendency for a lessened retention of water. Unless progressive dehydration is occurring, the serum protein concentration falls to a level below its initial value and remains below normal. This fall is

increased by an increase in the amount of water administered. This affords yet another indication of the addition of fluid to the circulating blood stream when a person is exposed to hot atmospheres. In none of these experiments was dehydration sufficiently severe or rapid in onset to bring about disproportionate effects upon the blood stream.

The effect of administering saline solution in improving the retention of body water is seen even within the experimental period. The benefit of the frequent drinking of small amounts of fluid instead of the infrequent drinking of large amounts is seen in the hot dry atmosphere.

The urine volume bears a much closer relationship to the general level of bodily hydration than to the concentration of serum protein. The concentration of chloride in the urine is affected by many factors. It varies with the general state of the chloride balance existing at the commencement of the day of observation, and inversely with the urine volume. It tends to be reduced by acclimatization to heat. The more important figure is the rate of chloride loss. This also is noticeably affected by the general state of the chloride balance. It tends to be reduced by acclimatization and to fall during the day. It tends to fall also on the day of administration of saline solution and when fluid administration is delayed, probably as a result of water retention. In the hot dry atmosphere the increased concentration of chloride did not make up for the reduction in urine volume, so that the chloride loss was less than in the hot wet atmosphere. The amount of fluid administered has little effect upon the urinary chloride loss.

That the rate of chloride loss in the urine is determined at least in part by factors other than those which determine the general rate of excretion of urinary solutes is shown by the fact that the rate of loss of non-chloride solids bears a much more definite and passive relationship to urinary volume. There are some indications for a specific sparing mechanism governing the renal excretion of chlorides when sweat loss is high, but these are not so strong as had been expected. Much of the effect previously interpreted^{40,41} as showing such a mechanism now seems to have been due to the operation of a diurnal factor not associated with heating. Non-chloride solids

TABLE VII.

	Atmosphere.	Sixteen Hours' Rest.			Eight Hours' Work.			Total for Twenty-four Hours.		
		Sweat.	Urine.	Total.	Sweat.	Urine.	Total.	Sweat.	Urine.	Total.
Water. (Cubic centimetres.)	Hot dry	3,300	670	4,030	3,640	330	3,970	7,000	1,000	8,000
	Hot wet	1,440	670	2,110	1,840	330	2,170	3,280	1,000	4,280
Sodium chloride. (Grammes.)	Hot dry	1.81	7.67	9.48	1.97	3.83	5.80	3.78	11.50	15.28
	Hot wet	0.53	9.20	9.73	0.68	4.60	5.28	1.11	14.33	15.01

are affected by a similar diurnal rhythm, but to a less pronounced extent, so that the ratio of chloride to non-chloride concentration also shows a diurnal rhythm.

Practical Applications.

A hot wet atmosphere imposes much less strain upon the salt-water balance of a person than does a hot dry atmosphere of the same effective temperature. While this does not negative the usefulness of the effective temperature scheme in the assessment of hot climates, it does provide an important exception to its application. Much more provision must be made against the loss of salt and water from persons living in hot dry climates. In Table VII are shown the figures indicating the average losses to be expected from a Queenslander undertaking for eight hours daily, in corresponding atmospheres, the grade of exercise used in these experiments. It will be seen that the major problem is the supply of sufficient water. The salt supply in the hot wet atmosphere should be quite within the bounds of an ordinary diet. The salt balance of Queenslanders in the hot dry climate can easily be achieved by a little care in cooking, although some improvement of general bodily hydration may be obtained by giving it more frequently, as in drinking water.

The continuous maintenance of bodily hydration by frequent small drinks is not of much consequence in the hot wet atmosphere, but both the degree of replacement and its frequency are of importance in the hot dry atmosphere. The best results are obtained by quarter-hourly libations of at least sufficient quantity to replace the total water loss.

While definite effects of acclimatization were not established in the course of these experiments, the low concentration of chloride found in the sweat of our Queensland subjects, as compared with London subjects, suggests that an important long-term acclimatization has already occurred. That such a reduction does occur with acclimatization has been suggested by other workers.⁽¹¹⁾ It might be of importance to examine newcomers to the tropics some time after their arrival, in order to determine whether such an acclimatization had occurred, especially if personnel is being selected for a long period of arduous work in a hot dry atmosphere with poor supply facilities. The sporadic occurrence of heat cramps in stockholders and the experiences on the Boulder Dam⁽¹²⁾ construction suggest the wisdom of this procedure.

As in the case of the pulse rate, afternoon exposure makes greater demands upon the salt-water balance than morning exposure.

Acknowledgements.

Grateful acknowledgement is made of the financial help given to these investigations by the National Health and Medical Research Council, and of the seconding of two officers to take a leading part in the work by the Director-General of Health, Commonwealth Department of Health. Gratitude is also expressed to the other members of the team whose names do not appear in the authorship of this report. We are also indebted to our subjects, who stood with fortitude the somewhat trying and monotonous conditions of the experiments.

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A REVIEW OF FIVE HUNDRED CONSECUTIVE CANCER AUTOPSIES.

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My work "The Spread of Tumours in the Human Body", published in 1934, included as an appendix a synopsis of 323 consecutive personally conducted autopsies on subjects of malignant disease, which were performed with the special object of ascertaining as completely as possible the modes of extension of the tumours and the situations of their metastases. Subsequently, between February, 1935, and December, 1937, at the Alfred Hospital, a further 177 consecutive cases were similarly studied; and the object of the present paper is to summarize the findings in the completed series of 500 cases. In all cases the post-mortem examination was completed according to the following routine procedure.

Autopsy Technique.

All thoracic and abdominal organs were removed from the body. The thoracic duct and *cisterna chyli* were examined *in situ* and, if diseased, were dissected out. When primary or secondary growths were known to be present in the head and neck, the tongue and cervical viscera were removed complete and were then carefully dissected; in other cases the cervical organs were examined *in situ*; but the thyroid was dissected out in all cases. The cranial cavity and brain were examined regularly.

but the spinal cord was removed only when disease was suspected in it. In all cases a slice was sawn from the front of the lumbar vertebrae. If no growths were found here, and if neither the clinical history nor external examination of the exposed skull, ribs and sternum suggested disease of the skeleton, no other bones were cut; but if skeletal disease was suspected, then the suspected bones, the upper half of one femur and usually the thoracic vertebrae were sectioned. All large solid viscera were cut into slices about one centimetre thick; but small organs, such as the thyroid, adrenal, prostate and testis, were cut into much thinner slices. The alimentary canal was slit open longitudinally throughout. Main veins in tumour areas were slit open and examined for possible invasion. All lymph glands were examined carefully. All tissues which preliminary examination failed to pass as normal were preserved in formalin solution and examined in greater detail later. Haematoxylin-eosin-stained paraffin sections of all significant abnormalities were prepared; and the nature of every lesion recorded in my book and in this paper was identified histologically. Special staining methods were used when appropriate.

In the following synopsis of the tumours in groups the case numbers serve for identification only. Details of noteworthy cases are included, and references regarding cases which have been reported elsewhere are given. In order to make this summary complete it has been necessary to repeat some parts of the earlier synopsis; but this repetition has been reduced to a minimum, and only cases unreported elsewhere have been described in any detail.

Epidermoid Carcinomata of the Head and Neck.

The sites of origin of the 64 epidermoid carcinomata of the head and neck, of which an earlier account of the histology and metastasis was published in 1930,⁽¹⁾ were: skin, 6; lip, 7; tongue, 20; tonsil, 5; palate, 2; pharynx, 17; larynx, 3; maxillary antrum, 1; alveolus, 1; and in two cases probably branchial cysts. Lymph gland deposits were present in 51 cases (80%). All but two of the 20 cases of lingual cancer, all but two of the 17 pharyngeal growths, and all five of the tonsillar growths were accompanied by deposits in lymph glands. The lymph glands were free of growth in four of the seven cases of lip cancer, in two of the three laryngeal cancers, in two of the six skin cancers, and in one of the two palatal cancers. The contrast between the frequency of lymphatic metastases from lingual, tonsillar and pharyngeal cancers on the one hand and laryngeal and lip cancers on the other is noteworthy. Invasion of the main cervical veins, usually the internal jugular vein, as described in my 1930 paper, was found in 30 cases (46%). Visceral metastases were found in 25 cases (39%). In all but one of these tumour invasion of cervical veins was present; while from only six of the 30 cases with invaded veins were visceral metastases absent. These facts clearly show the blood-borne nature of these metastases. The organs affected were: lungs, 19 cases; liver, 14; kidneys, 8; bones, 5; myocardium, 4; adrenals, 4; thyroid, 3; spleen, 2; pancreas, 2; voluntary muscles, 2; and stomach, intestine, brain, bladder and gall-bladder, each 1.

Noteworthy cases illustrating venous invasion, metastasis and difficulties of diagnosis have already been reported.^{(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11)} The following additional case deserves record.

CASE 340 was that of a male, aged sixty-eight years, with primary carcinoma of the tonsil (treated by radium), deposits in the cervical lymph glands, and invasion of the internal jugular vein. Metastases were present in the lungs, liver, left adrenal, pancreas, myocardium, thyroid and vertebrae; and there was nodular and diffuse carcinomatosis of the peritoneum, pleura and epicardium. Bilateral inguinal herniae were present, that on the right side containing the appendix and that on the left a piece of omentum: both the contents of the sacs and their walls were infiltrated by growth. Microscopically, in all situations the tumour was a well-differentiated epidermoid carcinoma with many keratinized cell nests.

A feature of interest in this group of tumours was its unequal distribution through the whole series of 500 cases.

Thus while 62 cases of carcinoma of the head and neck occurred in the earlier series of 323, only two additional cases occurred in the subsequent 177 autopsies. This difference was because the earlier series came in part from the Austin Hospital for Cancer and Chronic Diseases, where many patients with advanced and inoperable cranial cancer are sent from general hospitals, while the later series came wholly from a general hospital—the Alfred Hospital—where patients with advanced disease of this kind seldom die. This provides a good example of the fallacy of drawing uncritical statistical deductions from the records of a single institution or group of institutions. These usually fail to afford average samples of the whole community; in many ways, seen and unseen, their material is of a selected kind.

Rodent Carcinoma.

Five cases of rodent carcinoma, none with metastases, occurred in the earlier series of 373, and no additional cases occurred in the remainder of the series. The only noteworthy tumour was one of the shoulder, which had extended directly into the lung and spinal canal, and this has been described elsewhere.⁽¹⁰⁾

Carcinoma of the Salivary Glands.

In all three cases the carcinomata of the salivary glands were highly anaplastic cellular tumours of the parotid gland, with multiple blood-borne metastases in various thoracic and abdominal organs. The patients were two men, aged sixty-one and seventy-one years respectively, and a woman, aged thirty-seven years. In the last case the metastases included a large deposit in one breast.

Carcinoma of the Oesophagus.

In five of the 17 cases of carcinoma of the oesophagus no metastases were present. Lymph gland deposits were present in the remaining 12 cases, in five of which there were no other metastases. Visceral metastases were present in the liver in seven cases, in the lungs in three, in the brain in two, and in the pancreas, kidneys and bone in one case each. The bone deposit caused pathological fracture in the lower third of the shaft of the humerus of a man, aged sixty-eight years. In the two cases associated with cerebral metastases these had very similar situations; in one case there was a single nodule in the left occipital cortex, and in the other case each occipital pole contained a nodule of growth.

Carcinoma of the Stomach.

In six of the 85 cases of carcinoma of the stomach there were no metastases. Lymph gland deposits were present in 76 cases (89%). Cervical lymph glands, most frequently the left supraclavicular, were affected in 13 cases. Invasion of the *cisterna chyli* and thoracic duct from cancerous coeliac and lumbar glands had occurred in seven cases. Peritoneal dissemination was present in 26 cases. Direct invasion of the spleen by the primary growth or by deposits in contiguous lymph glands had occurred in six cases, causing fatal intragastric hemorrhage in two cases.

Visceral metastases were present in the liver in 39 cases (46%), in the lungs in 19, in the bones in six, in the ovaries in six, in the adrenals in four, in the myocardium in two, and in the thyroid and brain in one case each. In 14 of the 19 cases associated with secondary tumours in the lungs these were discrete and clearly blood-borne, while in the remaining five cases there was widespread permeation of peribronchial and pleural lymphatics with some nodulation, and it is uncertain whether the growths reached the lungs by the blood stream or by retrograde lymphatic spread from the hilar glands. In four additional cases tumour emboli were found microscopically in the arterioles of lungs which to the naked eye appeared free of growth.

Noteworthy cases, illustrating invasion of the main veins, have been recorded elsewhere.⁽¹⁰⁾ Case 143 was of interest, in that a small primary growth, which had escaped skiagraphic detection, had produced enormous

metastatic enlargement of the liver, which weighed 4,750 grammes. In Case 230, in which a severe grade of macrocytic hyperchromic anaemia with leucocytosis had been present, a small ulcerated pyloric carcinoma of scirrhous type was found to have produced widespread deposits in bones; and the lungs, which appeared normal, were found microscopically to contain many tumour emboli arrested in the pulmonary arterioles. In Case 305 a huge right ovarian tumour, weighing 2,400 grammes, was removed surgically and found microscopically to show disorderly adenocarcinoma with areas of signet-ring cell or Krukenberg type. Subsequent post-mortem examination disclosed extensive gizzard carcinoma of the stomach, with metastases in the lymph glands, the myocardium and the remaining ovary. Case 422, in which metastatic deposits in the cervical vertebrae from a symptomless carcinoma of the stomach eluded skiagraphic detection, has been described elsewhere,⁹⁰ as also has Case 451, in which gastric carcinoma was associated with acromegaly.⁹⁷

Carcinoma of the Small Intestine.

Carcinomata of the small intestine are rare, and this fact justifies brief notes on the following six examples.

Case 135 presented an ulcerated annular growth of the first coil of the jejunum, with large deposits in the mesenteric lymph glands, in a man, aged twenty-five years; microscopically this was a cellular anaplastic carcinoma. In Case 225 the patient was a man, aged forty-four years. The walls of all three parts of the duodenum were partly replaced by massive growth, but the papilla of Vater was intact. Large deposits were present in the mesenteric and lumbar lymph glands, and the *cisterna chyli* and lower half of the thoracic duct were occupied by growth. The lungs appeared free from growths, but microscopically they contained many minute metastases and intravascular tumour emboli. The tumour was an adenocarcinoma and simplex carcinoma. Case 434 was one of ulcerated annular carcinoma of the upper coil of the jejunum in a woman, aged seventy years; it replaced the bowel wall and adjacent mesentery, and was accompanied by deposits in the mesenteric lymph glands, severe peritoneal carcinomatosis and multiple metastases in the liver. Microscopically it was a rapidly growing adenocarcinoma with many mitoses. Cases 444 and 474 were both examples of argentaffin carcinoma ("carcinoid" tumour) with metastases. They have been fully described as Cases III and IV in a recent paper.⁹⁸ In Case 491 the patient was a woman, aged seventy-two years, who presented a rounded crateriform ulcer in the second part of the duodenum, which was diagnosed at autopsy as a simple chronic ulcer. Microscopic examination, however, revealed columnar-celled adenocarcinoma. There were no metastases.

Carcinoma of the Large Intestine.

In 21 of the 59 cases of carcinoma of the large intestine (that is, 36%) there were no metastases. Lymph gland deposits were present in 15 cases and peritoneal dissemination was found in 10 cases. Visceral metastases occurred as follows: liver, 31 cases (that is, 53%, in 11 of which there were no other metastases); lungs, seven cases (and in one additional case microscopic tumour emboli were found in the lungs); adrenals, three; kidneys, two; ovaries, two; and in one instance each metastases were found in the spleen, pancreas, thyroid, skin, *dura mater*, bones and cerebellum. Noteworthy is the high proportion of cases (53%) associated with hepatic metastases, which are often present even though the regional lymph glands are uninvolved, and which constitute the main factor in rendering the prognosis of intestinal cancer uncertain.

Noteworthy cases included: Case 2, in which an ovarian metastasis was surgically removed as a supposedly primary growth of the ovary;⁹⁹ Case 237, one of adenocarcinoma of the descending colon in a boy, aged sixteen years; and Case 488, in which the only blood-borne metastasis of an adenocarcinoma of the ascending colon in a woman, aged fifty-nine years, was a solitary growth, seven centimetres in diameter, in the right lobe of the cerebellum.

Carcinoma of the Liver.

Carcinoma of the liver is rare enough to justify a brief record of the five cases. Case 38, reported elsewhere,¹⁰⁰ was one of anaplastic carcinoma of the liver (which weighed 4,075 grammes) in a man, aged forty-seven years, with metastases in the liver itself, lungs, kidneys, *dura mater*, many lymph glands and peritoneum, including deposits in an inguinal hernial sac, and with extensive involvement of the *cisterna chyli* and thoracic duct.

Case 341, reported by Dr. A. J. Trinca and myself,¹⁰¹ was that of a woman, aged forty-one years, who had suffered for eleven months from pain in the back, and later from paraplegia of undetermined cause. This was due to large cystic metastases in the lumbar vertebrae from a primary adenocarcinoma of the liver, accompanied also by metastases in the liver itself, portal glands, peritoneum, left ovary and pelvic bones.

In Case 348, a man, aged sixty-four years, a heavy spirit drinker, had complained of abdominal enlargement and loss of weight of four months' duration and of jaundice of recent onset. Autopsy revealed huge carcinomatous replacement of the liver (which weighed 4,500 grammes) with many metastases in the liver itself, in which many points of invasion of hepatic and portal veins were observed, and in many upper abdominal lymph glands. The lungs appeared normal, but microscopically the pulmonary arterioles and capillaries were found to contain many arrested tumour emboli ranging in diameter from about 30 μ to 150 μ . The tumour was a cellular disorderly adenocarcinoma.

In Case 349 a woman, aged fifty-three years, had suffered from lumbar pain and loss of weight and strength of two years' duration. Autopsy revealed primary adenocarcinoma of the liver (which weighed 4,000 grammes), with multiple invasions of the hepatic veins, many small metastases in the lungs, and deposits in the upper abdominal and left supraclavicular lymph glands. Microscopic examination revealed in the lungs, in addition to visible growths, many arrested tumour emboli in small blood vessels.

In Case 421, a man, aged seventy years, was admitted urgently to hospital with a history of ten days' constipation and recent vomiting and abdominal distension. Laparotomy revealed widespread peritoneal carcinomatosis. Autopsy revealed also a hard white growth, 11 centimetres in main diameter, largely replacing the left lobe of the liver, a few small scattered metastases elsewhere in the organ, deposits in the mesenteric lymph glands, many metastases in most of the vertebrae, in the ribs, and in the crests of both ilia, and a single nodule in one kidney. The growth was a very scirrhous adenocarcinoma.

Two features of this small group of cases are worthy of note. In the first place, in none of the cases was there any gross evidence of cirrhosis of the liver. Secondly, with the exception of the first case, in which the growth was highly anaplastic, all the tumours were adenocarcinomata, and therefore presumably of bile duct origin, that is, malignant cholangiomata and not hepatomata or liver cell tumours. Thus while cirrhosis undoubtedly precedes many tumours of liver cell origin, this series shows that carcinomata of the intrahepatic bile ducts often arise in non-cirrhotic livers and that cirrhosis is not an important predisposing factor for growths of this type.

Carcinoma of the Main Bile Ducts.

In all three cases of carcinoma of the main bile ducts the tumours were well differentiated adenocarcinomata without metastases; in two instances they arose from the main hepatic ducts in the porta of the liver, and in the third case from the ampulla of Vater.

Carcinoma of the Gall-Bladder.

In three of the ten cases of carcinoma of the gall-bladder there were no metastases. Lymph gland deposits were present in six cases and peritoneal deposits in four cases. Visceral metastases were present in the liver in four cases and in the lungs in one case.

Carcinoma of the Pancreas.

In two of the 11 cases of carcinoma of the pancreas no metastases were present. Lymph glands were involved in eight cases, and there were peritoneal deposits in five

cases. Visceral metastases were distributed as follows: liver, 8; lungs, 2; bones, 2; myocardium, 2; and in 1 case each, adrenals, brain, thyroid and ovaries.

Noteworthy cases include the following. In Case 20 there was a double invasion of the portal vein.^(a) Case 295 was that of a man, aged forty-nine years, who was believed clinically to have a cerebral tumour; autopsy proved this to be a huge metastasis from a pancreatic adenocarcinoma, accompanied also by metastases in mesenteric lymph glands, liver, both adrenals and several vertebrae. Case 330 was first reported as a rare form of widespread primary carcinoma of the pancreas with metastases in the liver, small intestine, thyroid and heart;^(a) but in a later paper^(b) this opinion was modified, and I now believe the condition to have been one of simultaneous multiple primary argentaffin carcinomata ("carcinoids") of the intestine and pancreas. Case 459 was remarkable in that typical diabetes of long duration was due to an unsuspected carcinoma of the pancreas.

A woman, aged fifty-one years, first attended the diabetic out-patient clinic in November, 1935, complaining of thirst, polyuria and loss of weight during the previous two years. Examination revealed a large lower abdominal tumour, which was thought to be composed of uterine fibroids. She was admitted to hospital and operated on in December, when large bilateral ovarian tumours were removed. The pathologist's report on these was "columnar-celled adenocarcinoma of both ovaries, possibly secondary to alimentary carcinoma". The patient was discharged from hospital in January, 1936, and continued to attend the diabetic clinic, receiving insulin up to 50 units a day, in spite of which her urine usually contained some sugar. Her weight was maintained at about eight stone, although she suffered from intermittent vomiting attacks. She remained fairly well until April, 1937, when she was again admitted to hospital because of oedema of the right leg. Her fasting blood sugar level was found to be 0.37%. In May a mass was felt in the epigastrium and she died soon afterwards. Autopsy revealed an extremely scirrhous columnar-celled adenocarcinoma replacing the entire pancreas, except for a small area of residual tissue in the head of the organ. Small deposits were present in the neighbouring lymph glands, and there were metastases also in the liver and peritoneum.

Carcinoma of the Breast.

All the 45 patients who suffered from carcinoma of the breast were females. In only two cases were there no metastases. Lymph glands were affected in 36 cases (80%). The pleura was cancerous in 19 cases, the peritoneum in six, and the pericardium in two.

Visceral metastases were present in the lungs in 28 cases (61%); these were discrete and clearly blood-borne in 22 cases, while in six instances it was doubtful whether they were blood-borne or had developed by lymphatic permeation of the chest wall and transpleural spread. Metastases were present in the liver in 22 cases (49%), in bones in 21 cases (47%), in the adrenals in nine, in the thyroid in eight, in the *dura mater* in seven; in the brain in seven, in the kidneys in seven, in the spleen in four, in the intestinal mucosa in four, in the pancreas in three, in the ovaries in three, in the myocardium in two, and in the endometrium in one.

Noteworthy cases, illustrating extensive or unusual metastases and errors of diagnosis caused by metastatic growths, have been reported in earlier papers.^{(a)(b)(c)(d)(e)(f)(g)(h)(i)(j)(k)(l)(m)(n)(o)(p)(q)(r)(s)(t)(u)(v)(w)(x)(y)(z)} Examples of long-delayed metastatic or local recurrence were afforded by two cases.

In Case 42 the cancerous breast was removed early in 1919; the patient then remained well for nearly ten years, until at the end of 1928 a pathological fracture of the right femur occurred; autopsy a year later revealed extensive destruction of the upper end of the femur and the ilium by scirrhous adeno-carcinoma, and metastatic deposits also in the lungs, hilar lymph glands and epicardial surface of the left atrium.

In Case 290 amputation of the cancerous breast was performed in 1908, a small recurrent nodule was excised from the scar in 1912, and the patient then remained well for 15 years. In 1927 recurrent nodules again appeared in the scar and ulceration followed; and autopsy in 1929 revealed also metastatic growths in the opposite axilla, mediastinum, lungs, hilar glands, nearly all vertebrae, and the left pubis and ischium. The growth was a densely scirrhous *carcinoma simplex*.

Case 332 merits special comment because of the youth of the patient and the remarkable variations in the rate of growth of the tumour during and between pregnancies.

A young woman, aged twenty-two years, was admitted to hospital in July, 1933, with an "abscess of the right breast". Following the birth of her child eighteen weeks previously she had had sore nipples and hot tender breasts, and five weeks *post partum* "abscesses" in the breasts had been incised, but no pus was obtained. Later a firm lump had been noticed in the outer half of the right breast. Examination on her admission to hospital revealed a large firm mass in the breast fixed to the nipple and to the underlying muscles, and a single enlarged gland in the axilla. The breast was incised and much pus and debris were evacuated; the pathologist's report on a piece of excised tissue was "rapidly growing carcinoma simplex with great mitotic activity in an inflamed breast". Early in August the surgeon performed local mastectomy and the excised lactating breast was found to be extensively infiltrated by highly active carcinoma.

Some deep X-ray treatment was applied and, contrary to expectations, the tumour failed to recur. The patient remained well until October, 1934, when she noticed a painful lump in the left axilla. This increased and she was readmitted to hospital in January, 1935, with a mass of hard, tender left axillary glands. At this time she was six months pregnant, and the left breast presented changes consistent with the pregnancy. The right breast area remained unchanged. The enlarged glands were excised, and the pathologist's report was "massive carcinoma simplex showing extraordinary mitotic activity". It then became evident that the left breast was also the seat of widespread growth. In March a healthy child was delivered; and after this the breast tumour progressed very rapidly, skin nodules appeared in the neck and arm, and the patient died early in April, 1935. Autopsy revealed massive anaplastic carcinoma of the breast and thoracic wall with direct extension to neck, pleura, thymus and pericardium, but no remote metastases.

Remarkable features were the great initial activity of the growth during lactation, its subsequent twelve months' quiescence in spite of incomplete removal, and its sudden reappearance and rapid growth in the opposite breast during the latter part of the later pregnancy and lactation. These facts suggest that hormonal influences play a part, not only in the genesis of mammary cancer, but also in its rate of growth.

Carcinoma of the Uterus.

The 30 cases of carcinoma of the uterus comprised three distinct groups, as follows: (a) epidermoid carcinomata of the cervix (23 cases), (b) endometrial carcinomata of the corpus (six cases), and (c) mucoid adenocarcinoma of the cervix (one case).

In eleven of the cases in the first group there were no metastases. Lymph glands contained deposits in the remaining 12 cases, and the thoracic duct was cancerous in one case. Secondary growths were present in the liver in four cases, in the lungs in two cases and in the heart in two cases.

In the second group, one case was free from metastases. Lymph glands were involved in two cases, and peritoneal deposits were present in three cases. Metastases were present in the lungs in three cases, in the liver in two cases, and in the adrenals, ovaries and bones, each in one case.

Mucoid adeno-carcinoma of the cervix was represented by one case, with metastases in lumbar and mesenteric glands, contact invasion of the ileum and appendix, invasion of the right iliac vein, and mucoid metastases in the lungs.

Carcinoma of the Ovaries.

In the nine cases of carcinoma of the ovaries the tumours were bilateral in six cases and unilateral in three. Lymph glands were involved in six cases and the thoracic duct was cancerous in one case. Peritoneal carcinomatosis was present in eight cases, the pleura was affected by extension in three cases, and extension into the abdominal wall or umbilicus had occurred in three cases. Secondary growths were present in the lungs in two cases and in the liver in one case.

Carcinoma of the Fallopian Tube.

Case 131 was that of a woman, aged thirty-eight years, with a large cystic papillary carcinoma of the right Fallopian tube with coexisting tuberculous salpingitis. Widespread peritoneal dissemination was present and there were deposits in the abdominal, inguinal, mediastinal and cervical lymph glands.

Carcinoma of the Vulva.

In the two cases of carcinoma of the vulva the tumours were squamous-celled carcinomata with deposits in the inguinal lymph glands. In one case there were metastases also in the lungs and liver.

Carcinoma of the Prostate.

In four of the 15 cases of carcinoma of the prostate there were no metastases. Lymph glands were affected in nine cases and the thoracic duct was cancerous in one instance. Metastases were present in the lungs in six cases, in the bones in three, in the liver in three, in the *dura mater* in two, and in the spleen and adrenals, each once.

Carcinoma of the Kidney Parenchyma.

Lymph glands were affected in five of the ten cases of carcinoma of the kidney parenchyma. Renal veins were visibly invaded in seven cases, in four of which the main renal vein or inferior vena cava was involved. Metastases were present in the lungs in eight cases (and in one additional case intravascular tumour emboli were found microscopically in the lungs), in the liver in five cases, in the bones in four, in the opposite kidney in four, in the brain in three, in the thyroid in three, in the myocardium in two, in the adrenal in two, and once each in the pancreas and subcutaneous tissue. Noteworthy cases illustrating extensive or unusual metastases and diagnostic difficulties have already been reported.⁽¹⁰⁾⁽¹¹⁾⁽¹²⁾

Carcinoma of the Renal Pelvis.

There were three cases of carcinoma of the renal pelvis.

In Case 217, a man, aged forty-seven years, with recently enlarged glands in the neck, was thought to have Hodgkin's disease; but biopsy of an excised gland revealed metastatic growth. Subsequent autopsy revealed anaplastic carcinoma of the right kidney with metastases in many lymph glands and in the omentum, myocardium, liver, left kidney, ribs, vertebrae and femur.

In Case 228, a man, aged thirty-nine years, suffered from lumbar pain and a mass in the left side of the neck, and in skiagrams a large left renal calculus was seen. Later autopsy revealed extensive epidermoid carcinoma of the severely disorganized calcareous kidney, with deposits in many lymph glands, a cancerous *cisterna chyli* and thoracic duct, extensive lymph vessel carcinosis of the lungs, and discrete metastases in the liver.

Case 293 was that of a man, aged fifty years, who underwent nephrectomy for papillary epidermoid carcinoma of the left kidney. Subsequent autopsy revealed a large recurrent growth in the loin, with deposits in many lymph glands, and discrete metastases also in lungs, liver, right adrenal and cerebellum (a single large nodule in the right lobe).

Carcinoma of the Bladder.

In three of the five cases of carcinoma of the bladder there were no metastases. In Case 214 there were metastases in the omentum, in many abdominal lymph glands and in the liver. Case 383, one of carcinoma of the urachus, deserves special comment.

A woman, aged sixty-five years, who had had hematuria and abdominal enlargement for some months, was found *post mortem* to have a large gelatinous tumour of the fundus of the bladder, with ulceration into this organ and rupture of the upper surface of the growth into the peritoneal cavity. Examination of the peritoneum revealed massive deposits of gelatinous growth; and there were deposits also in the retroperitoneal, iliac and inguinal lymph glands, with invasion of the *cisterna chyli*. Microscopic examination revealed a highly mucoid signet-ring-celled carcinoma and adenocarcinoma, a type of structure pointing to the urachal origin of the growth.

Carcinoma of the Lung.

Detailed review of the 27 cases of carcinoma of the lung is warranted by the generally insufficient recognition of the frequency of pulmonary cancer and by its great importance in causing diagnostic difficulties. As the present material illustrates, in many cases the primary growth is symptomless or nearly so, and it is the metastases which cause the first symptoms and dominate the clinical picture. Moreover, the metastases are apt to be numerous and widespread and to occur in unusual situations.

In none of the 27 cases were metastases absent. Lymph gland deposits were present in 25 cases (93%). The pleura was cancerous in eight cases, the pericardium in seven and the peritoneum in three cases. The great veins (the pulmonary, the superior vena cava or the innominate) were invaded by growth in 13 cases and a main pulmonary artery in one case. Visceral metastases were present as follows: liver, 15 cases; adrenals, 12; brain, 9; lungs, 9; bones, 8; kidneys, 4; myocardium, 3; thyroid, 2; pancreas, 2; ovaries, 2; spleen, prostate, skin, intestinal mucosa, gall-bladder and pituitary gland, one case each. Particularly noteworthy are the high incidences of adrenal and brain metastases, 44% and 33% respectively. Not uncommonly the brain and adrenals are involved together and are the only sites of blood-borne metastases; this was so in four cases in this series—Cases 364, 438, 449 and 477. Cerebral metastases may grow to a large size—for example, 10 centimetres in diameter in Case 389.

Difficulties of Clinical Diagnosis.

Difficulties of clinical diagnosis were well exemplified in this series. In 15 of the 27 cases diagnosis prior to autopsy had been erroneous or indefinite. In 11 of these cases metastatic growths had produced the main clinical features of the disease; in three cases chronic intrathoracic disease was recognized, but its nature was misdiagnosed; and in one case (364^{cm}) a large pulmonary carcinoma with metastases was found in a man, aged seventy-seven years, who had died from a sigmoid volvulus.

Of the 11 cases associated with clinically obtrusive metastases, in four cases these were situated in the brain (182, 389, 438 and 477); the diagnoses were respectively "mastoiditis with intracranial complications", "cerebral tumour or abscess", "alcoholic confusional psychosis" and "cerebellar tumour" respectively. Two of these have been described in earlier papers;⁽¹¹⁾⁽¹²⁾ and the remaining two may be summarized briefly here.

Case 438 was that of a man, aged fifty-one years, a heavy drinker, who began to suffer from headache, mental confusion and vomiting; no definite neurological abnormalities were found; the *fundi oculorum* and the cerebro-spinal fluid were normal, a skiagram of the skull revealed no abnormality and the Wassermann test produced no reaction. A psychiatrist diagnosed "alcoholic confusional psychosis". Autopsy a few days later revealed a carcinoma of the periphery of the right middle lobe, small deposits in the hilar glands, replacement of the left adrenal by growth, and a metastasis in the central white matter of each lobe of the cerebellum.

In Case 477, a man, aged thirty-four years, presented symptoms of cerebellar tumour; recent "pleurisy" and a slight swelling in an intercostal space raised suspicions of lung cancer, but skiagrams had shown no positive evidence of this. Autopsy, however, disclosed carcinoma of the left lung with metastases in the hilar lymph glands, the right adrenal and the cerebellum, in which a single cystic metastasis, four centimetres in diameter, occupied the right lobe.

An enlarged cancerous liver constituted the main initial symptom in three cases (115, 445 and 446), leading to diagnoses of cancer of the stomach in two cases and cancer of the colon in the third case, in which laparotomy had been performed. Case 115 has been recorded elsewhere.⁽¹³⁾

In Case 136^{cm} spinal metastases with paraplegia had been misdiagnosed as tuberculosis. In Case 169^{cm} biopsy of a mass in the neck led to a histological misdiagnosis of probable "endothelioma" of cervical lymph glands. In Case 378^{cm} ascites due to peritoneal carcinomatosis had

been regarded clinically as probably tuberculous. Case 478, which presented a remarkable metastatic growth in a surgically removed hydrocele, misdiagnosed microscopically as "endothelioma", has been already described in detail.¹⁰⁰

The three cases in which a clinical misdiagnosis of known intrathoracic disease was made were briefly as follows. Case 263 was that of a woman, aged forty-eight years, with a brief history of cough, hæmoptysis and loss of weight, and a family history of phthisis; the clinical and skiagraphic diagnosis was "pulmonary tuberculosis", but no tubercle bacilli were found in the sputum; autopsy disclosed a large carcinoma of the upper and middle lobes of the right lung. In Case 355¹⁰⁰ post-pneumonic empyema was suspected, but autopsy revealed a huge carcinoma of the left lung complicated by suppurative pneumonitis. Case 447 was that of a woman, aged forty-eight years, whose history of "swallowing a bone which stuck in her chest" six months earlier, followed by persistent cough and signs of consolidation at the base of the left lung, led to a diagnosis of "probable foreign body in the lung". Skiagrams were compatible with this diagnosis, and bronchoscopy on two occasions revealed only inflammatory tissue; but autopsy disclosed a large left-sided carcinoma.

Carcinoma of the Thyroid.

The six carcinomata of the thyroid showed great diversity of structure and behaviour. In two cases the tumours were huge, rapidly-growing, undifferentiated polymorphous-celled carcinomata, associated with large deposits in lymph glands, invasion of main cervical veins and numerous blood-borne metastases in many organs. In a third case, in which the patient was a woman, aged eighty-one years, the huge primary growth consisted partly of similar highly anaplastic tissue and partly of well-differentiated cystic papillary adenocarcinoma, while metastases in lungs and lymph glands consisted only of the latter type of growth.

In Case 80, a man, aged sixty-seven years, suffered a pathological fracture of the trochanteric region of the femur; this was diagnosed skiagraphically as due to "sarcoma", and intensive deep X-ray therapy was applied. The bone lesion altered very little during the next eighteen months, when the man died from chronic nephritis with uremia. A post-mortem study showed the fractured area to be infiltrated by papillary adenocarcinoma, a metastasis from a small thyroid "adenoma".

Another example of "malignant adenoma", in this case with many metastases in bones and lungs, was afforded by Case 145, reported by Rosenthal and myself.¹⁰⁰ In this case some of the bone tumours had pulsatil; and parts of the growths had typical colloid-containing vesicles like that of normal thyroid.

Case 441 deserves special comment.

A woman, aged sixty-two years, was admitted to hospital with a slightly tender mass, 10 centimetres in diameter, of three weeks' duration, in the right axilla. This was diagnosed as an abscess and incised; no pus was obtained, and examination of a piece of tissue which was sent for microscopic study revealed a rapidly growing round-celled tumour of uncertain nature. Autopsy four weeks later showed that, although the thyroid was not enlarged, its right lobe was completely replaced by white soft growth, in which microscopic examination revealed a round-celled, diffuse structure like that of the axillary mass, but with acinar formation in places. Multiple metastases were present in the right cervical and axillary lymph glands and in the lungs and the solitary left kidney (the right kidney was developmentally absent). In the vertex of the skull there was a small single flat area of erosion, microscopic examination of which revealed well-formed colloid-containing vesicles. No other bone metastases were found.

Noteworthy features are the unusual and diagnostically misleading initial symptoms, the impossibility of making a correct diagnosis before autopsy, and the great range of histological structure in the growth, from undifferentiated round-celled tissue to normal-looking thyroid vesicles.

Other Carcinomata.

The five other carcinomata comprised one case each of seminoma of the testis, adamantinoma of the mandible,

carcinoma of the thymus, chorioncarcinoma, and a rare, richly glycogen-containing cystic papillary adenocarcinoma of the skin of the neck in a woman, aged seventy-two years, with metastases in the cervical lymph glands, lungs and liver.

Sarcomata.

The 26 cases of sarcoma are divided into four groups, as follows:

Lymphosarcoma (Seven Cases).

The sites of origin of the lymphosarcomata were abdominal (retroperitoneal, mesenteric) in six cases and anterior mediastinal in the remaining case. In all cases there was extensive spread to other groups of lymph glands; and in some of the cases massive infiltration of the wall of the intestine, infiltration of the liver or enlarged spleen was found. In Case 458, in which a retroperitoneal lymphosarcoma occurred in a man, aged forty-four years, there was a patch of metastatic growth in the mucous membrane of the larynx.

Leiomyosarcoma (Five Cases).

The sites of origin of the leiomyosarcomata were a myomatous uterus in three cases, the rectum in one case and the retroperitoneal tissues in one case. In all three of the uterine cases remote blood-borne metastases were present; in Case 235 there was a huge solitary metastasis in the right lung; in Case 269 multiple metastases in the liver, a central deposit in one rib and a single metastasis in the cranial *dura mater* were found; and in Case 392 multiple metastases were present in the lungs and many vertebrae. The clinical record of this last case was of particular interest.

During convalescence following hysterectomy of the supposedly simple myomatous uterus the patient complained of pain in the back, and skiagrams revealed areas of destruction in the lumbar vertebrae; reexamination of the uterus then disclosed an area of sarcoma in one of the myomata. The patient died suddenly a few weeks later, and autopsy revealed that the immediate cause of death was a large tumour embolus, which had been dislodged from an area of gross invasion of the inferior vena cava and had been arrested in the main left pulmonary artery.

In the case of leiomyosarcoma of the rectum in a man, aged forty-four years, there were multiple metastases in the liver only. The retroperitoneal myosarcoma was a huge tumour, weighing 9,600 grammes, and the patient was a man, aged forty-two years; the only metastases were a few satellite nodules in the mesentery.

Sarcomata of Bone (Four Cases).

The four cases of sarcomata of bone comprised two cases of osteogenic sarcoma of the femur, one in a woman, aged thirty years, with metastases in the lungs, ilium and a rib, and the other in a boy, aged fourteen years, with osteoid metastases in the lungs, and two huge chondrosarcomata, one of the ribs in a man, aged sixty years, and the other of the femur in a man, aged sixty-nine years, neither associated with any metastases.

Other Sarcomata (Ten Cases).

The other sarcomata were as follows. In Case 57, a male patient, aged sixty-six years, was found to have spindle-celled reticulum sarcoma (endothelioma) of lymph glands with widespread metastases in many organs. In Case 73 the patient was a female, aged thirty-nine years. Round-celled sarcoma of the soft tissues of the thigh was present, with gross invasion of many veins, including the inferior vena cava. The patient died suddenly from massive tumour embolism of the lungs and metastases in the lungs and myocardium. In Case 102 the patient was a male, aged twenty-one years. Round-celled sarcoma of the soft tissues of the supraspinous fossa of the scapula was present, with metastases in lymph glands, lungs and bones. In Case 410 the patient was a male, aged eight years. Round-celled sarcoma of the axilla was present, with metastases in the lymph glands. In Case 78 a female patient, aged seventy years, had recurrent fibrosarcoma of the calf without metastases. In Case 454

a male patient, aged sixty-seven years, had fibrosarcoma of the base of the skull, with metastases in the lungs and in the vault of the skull.⁽¹⁷⁾ In Case 203 a female patient, aged seventy-two years, had polymorphous-celled sarcoma of the pectoral region with metastases in the lungs.⁽¹⁸⁾ In Case 260 a female patient, aged forty-one years, had polymorphous-celled sarcoma of the retroperitoneal tissues with metastases in the peritoneum, lungs, brain and subcutaneous tissue of the trunk and limbs. In Case 218 a female patient, aged fifty-five years, had polymorphic-celled sarcoma of the tendon sheath of a toe (described clinically by King⁽¹⁹⁾) with metastases in the inguinal, iliac and lumbar lymph glands. Case 465, of sarcoma arising in an old psoas abscess cavity, deserves special comment.

A woman, who was forty years old when she died, had had a chronic left psoas abscess with recurrent discharge in the groin for twenty-six years. For the last seven months of her life a firm mass had appeared in the iliac fossa and had enlarged steadily, and skiagrams revealed metastatic growths in the lungs. Autopsy revealed a huge, white, partly degenerated growth, largely replacing the ilio-psoas muscle; there were many firm spherical metastases in the lungs only. Microscopic examination revealed a polyhedral-celled and spindle-celled growth, probably an anaplastic fibrosarcoma.

The presence of multiple pus pockets around the psoas tumour and of bony ankylosis of the sacro-iliac joint suggested that the psoas abscess had originally arisen from an infective sacro-iliac arthritis; there was no evidence of tuberculosis in the affected area.

Malignant Melanoma.

The origins of the four malignant melanomata were the eye in one case (reported elsewhere⁽²⁰⁾) and the skin in three cases. Two of the cutaneous cases presented interesting diagnostic difficulties and have already been reported;⁽²¹⁾ and the third case was one of melanoma of the vulva in a woman, aged seventy-five years, with metastases in the inguinal and iliac lymph glands, the lungs, liver, ribs and vertebrae. In all four cases there were many blood-borne metastases in various organs.

Metastasizing Uterine Adenomyoma.

Case 294 was that of a woman, aged fifty-eight years, who died from a recurrent pelvic growth five months after subtotal hysterectomy for "fibroids". Autopsy disclosed, in addition to recurrent abdominal tumours, several small, firm, spherical nodules in the lungs. Microscopic examination of these tumours revealed well differentiated, benign-looking, smooth muscular tissue with occasional gland acini scattered through it. Examination of the abdominal tumours revealed only disorderly spindle-celled sarcoma. The only reasonable interpretation would appear to be that rapid sarcomatous growth supervened in a mixed uterine tumour, which had already produced small "benign" adenomyomatous metastases in the lungs.

Sacral Chordoma.

Both cases of sacral chordoma have been described in detail elsewhere.^(22,23) In both remote blood-borne metastases were present, in one case in many organs and in the other in the liver only.

Neuroblastoma of the Adrenal.

There were two cases of neuroblastoma of the adrenal. Case 297 presented a huge retroperitoneal tumour, which had presumably arisen from the left adrenal, in a girl, aged thirteen years. Discrete metastases were present in the liver, lungs and ribs. Microscopic examination revealed a diffuse, round-celled growth, with imperfect but unmistakable rosette formation in the primary tumour and in the hepatic metastases. In Case 304, in which the clinical diagnosis had been "Ewing's sarcoma of the femur", in a girl, aged eight years, the lesion was found at autopsy to be a small primary neuroblastoma of the right adrenal with many metastases, including the large tumour in the femur. A full account has been given by Colville and myself.⁽²⁴⁾

Primary Intracranial Tumours.

The primary intracranial tumours, of which there were 39, comprised the following groups.

Gliomata (Thirty-One Cases).

With increasing experience of gliomata I have abandoned the terms "astrocytoma", "astroblastoma", "spongioblastoma" and "glioblastoma" as designating distinct entities. All transitions are to be seen, even in a single tumour, between slowly growing, highly differentiated fibrillary astrocytoma and rapidly growing anaplastic polymorphous-celled glioblastoma. Imperfectly formed astrocytes and glial fibres are often to be seen in parts of otherwise highly undifferentiated cellular growths; and it is clear that we are dealing with a single group of tumours, astrocytic in origin, of variable degrees of differentiation and rate of growth. Of this "astrocytoma-glioblastoma" group there were 26 cases in the present series. Other distinct types of gliomata were medulloblastoma of the cerebellum (three cases) and ependymoma and oligodendroglioma (each one case).

Meningioma (Five Cases).

In one of the five cases of meningioma, Case 469, a woman, aged fifty-six years, presented three separate meningiomata situated within the lateral ventricles.

Acoustic Neurofibroma.

There was one case of acoustic neurofibroma.

Malignant Pituitary Tumour.

The one case of malignant pituitary tumour was described in a previous paper,⁽²⁵⁾ as Case XVII.

Diffuse Meningeal Tumour.

The one diffuse meningeal tumour, occurring in a child, aged two years, has been described elsewhere.⁽²⁶⁾

Comment.

In none of these cases were any metastatic growths found, either in the cerebro-spinal spaces or in other parts of the body. The spinal theca, however, was not examined in all cases, so that some metastatic implants in this situation may have been missed.

Acknowledgements.

I am deeply indebted to Professor P. MacCallum for his never-falling interest in and critical discussion of unusual specimens; and to members of the honorary staff of the Alfred Hospital for access to the records of cases under their care. Dr. L. B. Cox has my special gratitude, not only for the help afforded by his wide knowledge of neuropathology, but also for his constant general interest in my work. To Mr. R. Prosser, senior assistant in the Department of Pathology of the Alfred Hospital, I am indebted for the expert preparation of most of the microscopic sections involved in this study, numbering altogether many thousands. Other sections were ably prepared by my wife.

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ECHINODERM INJURIES IN NAURU.

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THE sea-urchin, *Centrechinus setosus*, known in Nauru as the *enor* (Figure 1), is found attached to deep crevices in the coral. At times it may be detached from its foothold and then may also be found on more exposed portions of the reef. Its body may reach a diameter of three and a half or four inches, whilst the larger spines may be two and a half or three inches long. The smaller needle-like spines measure between one and two and a half inches. The spines are almost black in colour, but some have greenish bands, which give them an appearance not unlike those of the porcupine. Each spine has a rather stout base with a muscular attachment of the ball-and-socket type; this gives the free end of the spine a considerable range of movement. If a single spine is touched, the adjacent spines rotate so as to point towards the stimulated spine; this ensures that a maximal number of spines penetrate the stimulating object in question (for example, a foot) if its pressure is continued.

Each spine is liberally supplied with barbs which point towards the free end of the spine, these arrest the progress of an object impaled upon the spine. If the spine does not fracture (as it frequently does) the barbs permit the escape of the impaled victim, which, as in the case of a fish heavier than the sea-urchin, would

otherwise detach the sea-urchin from its anchorage. The smaller spines appear to be designed to cope with smaller enemies, which, dodging between the larger spines, are then held up by the smaller, closer-set series. Occasionally, when the *enor* has its habitat on exposed portions of the reef, the larger spines are broken off and rounded by the action of the waves; the animal then depends on the second, smaller set for protection.

If the spines penetrate an object or break off, a red fluid, resembling in colour a strong solution of potassium permanganate, is exuded from the fractured surface.

Injuries from these spines most frequently occur among Nauruans, who go barefoot onto the reefs. European bathers are occasionally injured when climbing upon piles, jetties *et cetera*, where the animals are sometimes found. Detached spines may occasionally be driven into the extremities by the action of waves.

Unlike the similar *Centrechinus antillarum* of the West Indies (Earle, 1940), the spines of which are readily phagocytosed in the human body, the spines of *Centrechinus setosus* appear to be relatively resistant to phagocytic action. Even when they are located in the superficial tissues, their total removal is extremely difficult owing to their extreme fragility, and the unremoved fragments may be seen on radiological examination many months after the original injury.

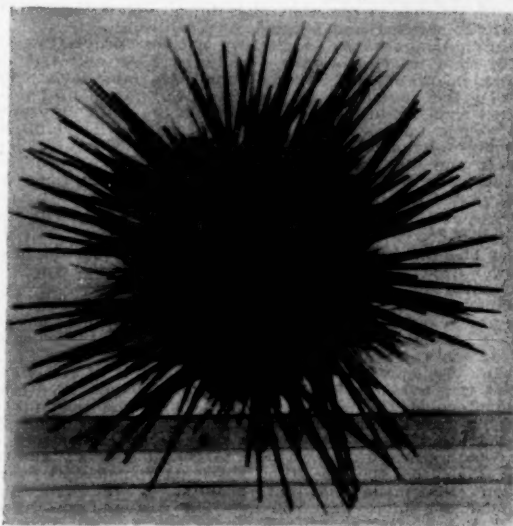


FIGURE 1.

The severe pain occurring immediately after penetration of the spines appears to be due to the red fluid inside the spines, for it is too intense to be explained by the mechanical injury alone. Apart from the injury, subsequent suppuration due to secondary infection of the puncture wounds is frequent. There appears to be no poisoning due to the spines themselves, such as occurs with the common sea-urchin of the Red Sea (Castellani and Chalmers, 1919).

The ova are grouped in loose, crescent-shaped segments and somewhat resemble caviare; individual ova measure one or two millimetres in diameter. They are pepper-coloured and have an unpleasant bitter taste. Although they are occasionally eaten by the Chinese in Nauru, no cases of allergic manifestation or food poisoning analogous to those occasioned by *Tripneustes esculentus*, the edible West Indian sea-urchin (Earle, 1940), have been reported.

Treatment.

Native Methods.—In Nauru, as in the West Indies, the native first-aid treatment for pain resulting from the puncture is to urinate on the wound immediately. The

action of the urine is to neutralise and dilute the red irritant fluid contained in the spines. A secondary measure is to place the injured foot into thick mud, the suction action of which is said to remove some of the more superficially placed portions of spine.

Surgical Treatment.—Prompt removal, surgically, is the ideal treatment. Prior to operation the injured part should be handled as little as possible, and poulticing should be avoided, since these measures provoke fragmentation of the spines and render their complete removal extremely difficult.

Prophylaxis.—Since secondary infection of the puncture wounds frequently occurs, sulphanilamide should be administered as a prophylactic, as in the case of injuries due to other marine animals (Earle, 1941).

Reports of Cases.

CASE I.—D., aged twenty-eight years, was a Nauruan house boy. He was first examined on October 4, 1940, when he complained of pain and swelling of the left foot and little toe. Three months previously, whilst fishing on the reef, he had accidentally stepped on a sea-urchin, several spines of which had penetrated his left foot and little toe. The visible spines were extracted at the time of the accident, a few others "worked their way out", and the foot healed. One month later the little toe swelled and became painful, but the swelling subsided again after poultices were applied. A week before the patient's admission to hospital the toe in question and the adjacent part of the foot again swelled and became very painful.

Examination revealed a healthy native, with no pathological signs apart from the foot lesion. The left toe, the adjacent part of the left foot and the interdigital cleft between the fourth and little toes were swollen, tender, and extremely painful on palpation. A pin-point sinus was seen at the outer border of the foot, at the level of the metacarpophalangeal joint, and another sinus existed between the little and fourth toes.

Under general anaesthesia the foreign bodies were removed; they proved to be portions of sea-urchin spines. After operation the patient was given a course of "M & B 693" and made an uninterrupted recovery.

CASE II.—G., aged twenty-four years, was a male Nauruan. He was first examined on November 21, 1940, when he complained of injuries received from an enor a week previously. On examination the right foot was found to be swollen and tender; puncture wounds could not be located. A radiological examination revealed the position of fragments of spines.

Owing to enemy action, only a limited supply of anaesthetic agents was available, and only one ampoule of "Pentothal Sodium" could be used for anaesthesia. The portions of spines were sought, and some, but not all, were removed, the operation being prematurely terminated on account of the rapid return of the patient to consciousness. On the same day, after the operation, a second radiological examination was made and the position of the remaining portions of spine was noted. The patient was given "M & B 693" post-operatively and made a good recovery.

Two months later a further radiological examination was made. It was seen that the portions of spine were still clearly present, though their outline was now slightly hazy, owing no doubt to phagocytic action. The patient has experienced no untoward symptoms in the interim.

Summary.

An account of the injuries due to echinoderms in the island of Nauru, Central Pacific, is given. These injuries are compared and contrasted with the injuries due to similar animals in other parts of the world.

Acknowledgements.

My thanks are due to Dr. B. H. Quin, senior medical officer, Administration of Nauru, for permission to use the clinical histories. Mr. W. Shugg, medical assistant, Nauru, is responsible for the photograph. Mr. K. D. Salter, of the Department of Zoology, University of Sydney, kindly arranged for the identification of the Nauruan sea-urchin; and Chief Austin Bernicke, Uaboe District, Nauru, provided several particulars concerning native treatments.

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A MEDICAL PAMPHLET OF 1845.

By C. CRAIG, M.D., M.S., F.R.A.C.S.,
Launceston.

"A LETTER TO THE MEDICAL PROFESSION OF VAN DIEMEN'S LAND."

O! If there be Justice in Heaven, and we are assured there is;

A day must come of ample retribution!

FOSCARL.

THE above is the inscription on the title page of a pamphlet written by W. R. Pugh, M.D., and printed by *The Launceston Examiner* in 1845. The pamphlet itself is one of those rarities sought after by the collector. Its contents have considerable interest, both human and clinical.

The pamphlet deals with the extraordinary circumstances that attended and followed an operation for strangulated hernia, performed in Launceston in the year 1841. It would seem that at that time there was raging in Launceston what was known locally as "the medical row". There were two parties to this "row", headed on the one side by Mr. Pugh, surgeon, and on the other by Mr. Doughty, surgeon. On the evening of Monday, November 1, 1841, Mr. Williams, a well-known and prosperous merchant, went to the theatre with his family. Half-way through the performance he was seized with severe griping pains in the abdomen and had to be assisted home. He attributed the pain to sauterne, cucumber and cheese. However, his condition did not improve, and at three o'clock in the morning the family physician, Dr. De Dassall, was called in. Dr. De Dassall first of all gave some castor oil and opium. He then gave a rectal injection of tobacco and waited until this had taken effect. He then left the chamber. In three-quarters of an hour Mr. Williams rang the bell and sent the servant to bring the doctor in again, as the pain had returned. Dr. De Dassall then suggested that he should examine the abdomen, and on doing so discovered an inguinal hernia on the right side. He then attempted to reduce the hernia "by the employment of the taxis". When this failed he consulted Mrs. Williams, and it was decided to send for Mr. Benson. When Mr. Benson arrived a warm bath was given. Three grains of antimony tartrate mixed in an ounce of water were administered every five minutes. This was sufficient to excite vomiting. "The taxis" was again tried, but failed. Dr. Gaunt was then called in, and on his advice the patient was bled standing until he fainted. It was now after noon on the Tuesday, and everyone was thoroughly alarmed. Mr. Bartley, a friend of the family, took Mr. Benson aside, and on his advice at once went out to fetch Mr. Pugh. Mr. Pugh arrived at three o'clock. After consultation with the other doctors it was decided that an operation was necessary. Still another physician, Dr. Salmon, of Perth, was called in, however, and he was driven to the door a few minutes before the operation commenced at five o'clock. By common consent it was decided that Mr. Pugh should operate. The operation took place in the patient's home. There is no mention of narcosis. The operation went well, and, after Dr. Salmon had placed his fingernail under a band and Mr. Pugh had divided this, the tumour was returned to the abdomen.

After having reduced the hernia, the edges of the sac and its coverings were brought into opposition by two points of suture: a piece of lint was applied to the wound, secured by a bandage, and the patient left to repose. Upon retiring to another apartment, each of the gentlemen who had assisted at the operation assured Mr. Pugh of their conviction that operative measures could not have placed the patient in more favourable circumstances than those in which he had been left.

On the following day the patient spoke of the relief he had obtained, and alluded to Mr. Pugh in "the kindest, most affectionate and grateful terms". After this, however, things did not go well. Although he had no more pain, the patient did not cease vomiting, and he died on the fifth day after the operation.

A post-mortem examination was made in the presence of all the medical gentlemen who witnessed the operation. A number of gentlemen, friends of the deceased, were also in attendance. Amongst these was "that exceedingly intelligent and scientific investigator of nature, Count Streleski". There was also present another medical man, who had not been present at the operation, and this was Mr. Doughty. Mr. Doughty is undoubtedly the villain of this narrative. He was the leader of the faction opposing Mr. Pugh. He had not been invited to attend at the operation, and when he entered the post-mortem room he had obviously made up his mind to find something wrong. In the light of after-events, the important point to be established at the post-mortem examination was whether or not there was a lump in the inguinal region. There were about fourteen people present at the post-mortem examination. Of these at least thirteen did not see any lump. But Mr. Doughty saw one. As soon as the sheet was removed he exclaimed mentally: "Good God! Why, what's that? There's the tumour." During the examination he muttered to Pugh: "Why was I sent for now he is dead? I might have been of some service before."

After the examination Mr. Pugh met him in the street and argued with him that the intestine was returned in consequence of Mr. Doughty having said that the intestine was never returned. Mr. Doughty adhered to his opinion, and in consequence of Mr. Doughty adhering to his opinion Mr. Pugh said: "Ah! well, never mind, you remember your case at the hospital", to which Mr. Doughty replied: "You will please remember, Mr. Pugh, that the knife on that occasion was in the hands of my superior, and that if any blame attaches to what you allude to, that blame is not mine."

At all events Mr. Williams was buried, and it seemed that the matter had ended. This, however, was far from being the case. In August, 1842, several months after the death of Mr. Williams, Mr. Pugh was astonished to receive a summons requiring him to attend the police court to answer a charge that he had treated the deceased gentleman with "gross negligence, ignorance, and rashness, and had thereby occasioned his death". The way in which this summons came to be issued was as follows. In June, 1842, there arrived in the colony a young Dr. Haygarth. This young man was evidently "taken up" by the Doughty faction. At all events, one evening he attended a "medical solr  e" at the house of Mr. Doughty. What transpired there was later described by his counsel.

During the course of the evening the conversation turned upon medical subjects, and it was then stated that Mr. Williams had come to his death by maltreatment of Mr. Pugh. These statements were made by Dr. De Dassall, the medical attendant of the family, and others confirmatory thereof were given by Mr. Doughty, who attended the post-mortem. Dr. Haygarth, in the natural language of one jealous of the honour of the profession, mindful of the well-being of society, the safety of individuals, and security of the public, immediately expressed his surprise that no investigation had taken place. Careless whom he might offend, and in the height of his indignation even for a while forgetting the common rules of courtesy, he upbraided those present with want of manliness, in not having at once gone forward to substantiate so serious a charge.

He himself at once went before a justice of the peace and laid information against Mr. Pugh, and a summons was served on that gentleman. The case was duly brought before the magistrates. All those who took part in the operation and those who attended the autopsy were examined, even the man who washed the body. It was clearly proved that after the operation there was no lump to be seen in the inguinal region, and the case was dismissed.

The next move came from Mr. Doughty, who tried to clear himself of being "a plotter and concocter with Dr. Haygarth of a system of enmity and annoyance to Mr. Pugh". He wrote to *The Examiner*, explicitly dis-

avowed all connexion with Dr. Haygarth, and tried to explain that, as the sac had not been removed, it must have been this that produced the tumour he saw. *The Examiner*, however, would have none of this, and a biting article was published, ending with this paragraph:

But having made these remarks on Dr. Doughty's letter, we are quite ready to construe in the most favourable manner the motives of his appearance as a witness. It requires a much more extensive knowledge of his disposition than we possess, to judge whether or not he was in error or mistake; but we are more inclined to adopt that view from his distinct disavowal that he was a party to the prosecution; and we put it to his candour whether he was not more likely to be mistaken than so many other gentlemen; or whether, if he will not allow the honesty or competency of their testimony, he ought to complain that the public, with the knowledge that he was not on friendly terms with the accused, should look with suspicion on his own.

Now as to Dr. Haygarth: it is impossible to say at this date whether he was genuinely indignant or whether he was "a plotter and concocter". Whatever he was, he must have bitterly regretted the day that he attacked the formidable Pugh. Pugh at once brought an action against him for malicious prosecution, the damages being laid at £1,000. The case came on for hearing on January 6, 1843, before His Honour Sir John Lewis Pedder, knight, chief justice, and a special jury. The dominating figure at the trial was Mr. McDowell, who appeared for Mr. Pugh. McDowell was the leading criminal barrister of Van Diemen's Land in those times, and defended many famous criminals, including Martin Cash. This is a specimen of his cross-examination of Doughty. It will be remembered that at the post-mortem examination Mr. Doughty had not made any open remarks to the effect that anything was wrong; he had merely "mentally exclaimed".

Mr. McDowell: "Do you know for what purpose you were called to witness the examination?"

Witness: "I do not know who sent for me, but I understood it was Mr. Pugh."

Mr. McDowell: "Were you called for use or for ornament?"

Witness: "I leave that to be supposed."

Mr. McDowell: "I presume you know the purpose of a post-mortem examination?"

Witness: "It is generally to ascertain the cause of death."

Mr. McDowell: "Then your extreme delicacy prevented you from mentioning what you have described?"

Witness: "I did not know whether I was called in as a medical gentleman or as a friend of the plaintiff's."

Mr. McDowell: "And you did not think it right to make public the symptoms you observed out of pure friendship to the plaintiff?"

Witness: "Yes, but I should have pointed them out had I considered myself attending professionally; I mentioned them afterwards to the plaintiff, when he was by himself."

The case went against Haygarth from the start. The jury was absent about a quarter of an hour and brought in a verdict for the plaintiff with damages of £250. "The case occupied the court till past five in the afternoon, and created considerable excitement." The defendant was unable to pay damages and was sent to His Majesty's Gaol in Hobart Town, from where, after twelve months' imprisonment, he was liberated under the Insolvent Law, having sworn that he had not one shilling to offer in liquidation of the damages and costs.

Of those who were involved in the "medical row", all are now forgotten with the exception of Pugh. Pugh arrived in Launceston in 1835 and left for Melbourne in 1854. The details of his career show him to have been a zealous and public-spirited practitioner. His main claim to remembrance, however, is the fact that he was one of the first in Australia to use ether. In this connexion the following paragraph, taken from *The Hobart Town Courier* of September 8, 1847, is interesting:

The Lord Bishop of Tasmania has recently sent out to the colony two sets of the apparatus used for the inhalation of sulphuric ether, the wonderful effects of which when used as a means of deadening pain produced by surgical operations appear to be gaining confirmation from the daily experience of leading members of the medical profession at home. Its application is now represented to be universal from the severest operations that the human frame can

undergo to the extraction of a tooth. It would appear to be equally useful in the treatment of nervous derangements of another class having been applied with the best results to cases of epilepsy in which it removes all mental anxiety and sense of pain and converts the approaching fit into a painless and soothing dream. With an affectionate remembrance of his colonial charge and a desire to relieve the sufferings of many to whom the new discovery is especially calculated to afford benefit, the Bishop has recently sent to Dr. Pugh of Launceston two sets of the requisite apparatus, one for his own use and one presented to Dr. Bedford. They are upon the most approved construction, and are accompanied, with thoughtful care, by a supply of sulphuric ether, in case there should be any difficulty in procuring it here.

The house in which Pugh lived still stands. It has been a doctor's house for over a hundred years, and is at present used as consulting rooms by Sir John Ramsay.

Reviews.

MODERN THERAPY IN GENERAL PRACTICE.

PROFESSOR DAVID BARR, of Washington University, has undertaken the colossal task of sponsoring the production of three formidable volumes, amounting to some three thousand five hundred pages, in order to provide the general practitioner with a reliable book of reference on modern treatment.¹

Most of the contributors to "Modern Medical Therapy in General Practice" are teachers of some distinction in the United States of America, and the names of many of them will be familiar to teachers in our own universities. That each individual article is written with a special knowledge of the requirements of general practice and with the authoritative conviction of an experienced specialist will soon become obvious to the reader.

It is pointed out by the editor that in the last forty years the subject of medical treatment has become so complex, the agents and methods employed so numerous and varied, that no single individual can possibly have mature judgement in the entire field. Adequate presentation is possible only by cooperative effort and by utilization of the experience of many specialists who are qualified to give a balanced statement of the latest development in the treatment of disease. Cooperation has been most effective in this publication, which the general practitioner will find a ready help in time of trouble. Each subject is prefaced with a concise account of the aetiology, pathology and social implications of the disease, followed by a clear exposition of the modern therapeutic measures which have been found to be of practical value in the alleviation or cure of the condition.

In the first volume detailed information is given concerning the various means at our disposal for bringing relief to the sufferer. This appears under the following headings: psychotherapy, the use of drugs, vaccines and sera, organotherapy, parenteral fluid administration, blood transfusion, dietotherapy, physiotherapy, climate and weather effects, occupational therapy and miscellaneous procedures, including artificial respiration, thoracentesis, artificial pneumothorax, lumbar puncture and urethral catheterization. In the succeeding chapters several important subjects are dealt with in a complete and thorough manner, particularly those relating to *diabetes mellitus*, allergic conditions and deficiency diseases.

In the second volume a great deal of space is given to the infectious diseases. The sound advice proffered for the guidance of the practitioner in dealing with tuberculosis is typical of many articles in this section. Every aspect of the management of syphilis is presented clearly and exhaustively; but a deplorably defeatist attitude is evident when it comes to the treatment of female gonorrhoea. One sentence is enough to reveal the unnecessarily gloomy view taken by the author: "The dull, drab picture which gonorrhoea in the female continues to present remains an eyesore and a challenge to medical science." Surely with efficient local treatment and, if need be, the liberal administration of sulphapyridine compounds most patients should be rendered non-infective within the space of three or four months. The latter part of this volume is taken up with sections on the nervous and digestive systems.

¹ "Modern Medical Therapy in General Practice", edited by D. P. Barr, A.B., M.D., LL.D.; Three Volumes; 1940. London: Baillière, Tindall and Cox. Super royal 8vo, pp. 3,561, with 1,251 illustrations. Price: 69s. net.

The third and last volume is no less interesting and important than those preceding it, and covers a wide variety of subjects, which include the respiratory and circulatory systems, the hematological dyscrasias and ductless glands. Perhaps the sex hormones are still rather difficult to present in a lucid style. Even if the text is not crystal clear, at least some help might be given with an occasional diagram instead of the representation of structural formulae, which the general practitioner finds difficulty in mastering at any stage of his scientific career.

Professor David Barr has done a good service to his profession, and indirectly to the public, in compiling this valuable encyclopædia of medical treatment. It will substantially supplement the armamentarium of those continually engaged in the front-line fight against disease.

OBSTETRICS.

THE second edition of "A Short Textbook of Midwifery", by G. F. Gibberd, has been published.¹ In September, 1938, we welcomed the first edition as "a concise and lucid statement of accepted obstetrical teaching" that will be welcome to the student. The author has tried to keep this book up to date. The physiology of the foetus has been described in the light of work by Barcroft. Barcroft has shown that the foetus in utero makes respiratory movements. The question, the author points out, is not "what makes the infant breathe after it is born?" but "what is the difference between pre-natal and post-natal respiratory movement and what are the factors which account for the difference?" "The cause of the so-called 'first breath' is a sudden awakening of the nervous system, not a sudden increase in the chemical stimulus to respiration." The author has introduced metric equivalents of measurements and doses, and he has deleted reference to the De Ribes bag. The author in the preface to this edition also acknowledges his use of work in pathology by H. L. Sheehan.

This edition can be just as warmly recommended as the last.

Notes on Books, Current Journals and New Appliances.

SPECIALIZED WAR SURGERY.

A SERIES of articles from *The Practitioner* have been reprinted and issued in book form under the title "Special Surgery in War Time".¹ The first on head injuries is by D. W. C. Northfield, and the second on the diagnosis and treatment of spinal cord injuries by Douglas McAlpine. Zachary Cope's contribution on abdominal injuries and wounds is well planned; he deals with the different types of injury, describes the symptoms and discusses the diagnosis in a masterly fashion. In the section on treatment he insists that the operating surgeon should always be on the lookout for multiple injuries. This is a necessary precaution that might be easily overlooked. Equally important is the advice given by T. Holmes Sellors in the chapter on chest injuries in modern warfare, that the patient should be undressed as soon as possible so that a careful search may be made for wounds, not only in the chest, but over the whole body. Sellors insists that the treatment of chest injuries in their early stages is of such importance that it cannot be over-emphasized. A. B. Wallace writes on the treatment of burns; though he mentions other methods, he deals in detail with the tannic acid method. He discusses initial shock and secondary shock as well as acute toxæmia and septic toxæmia. The book ends with an appendix on sulphonamides.

¹ "A Short Textbook of Midwifery", by G. F. Gibberd, M.B., M.S., F.R.C.S., F.R.C.O.G.; Second Edition; 1941. London: J. and A. Churchill Limited. Demy 8vo, pp. 556, with 194 illustrations. Price: 18s. net.

² "Special Surgery in Wartime", edited by Sir Humphry Rolleston, Bt., G.C.V.O., K.C.B., M.D., D.Sc., F.R.C.P., and A. Moncrieff, M.D., F.R.C.P.; 1940. London: Eyre and Spottiswoode (Publishers) Limited. Demy 8vo, pp. 74. Price: 6s. net.

The Medical Journal of Australia

SATURDAY, SEPTEMBER 6, 1941.

All articles submitted for publication in this journal should be typed with double or treble spacing. Carbon copies should not be sent. Authors are requested to avoid the use of abbreviations and not to underline either words or phrases.

References to articles and books should be carefully checked. In a reference the following information should be given without abbreviation: Initials of author, surname of author, full title of article, name of journal, volume, full date (month, day and year), number of the first page of the article. If a reference is made to an abstract of a paper, the name of the original journal, together with that of the journal in which the abstract has appeared, should be given with full date in each instance.

Authors who are not accustomed to preparing drawings or photographic prints for reproduction are invited to seek the advice of the Editor.

SEX HORMONE THERAPY IN THE MALE.

A GREAT deal of uncertainty and some misapprehension exist in the minds of many practitioners regarding the indications for the use of sex hormones and the results that are likely to follow their exhibition. This should not occasion great surprise, for the branch of medicine known as endocrinology is one of the newer branches of medical science, it covers a wide field and sends shoots into all kinds of unsuspected corners. It is also a field of much difficulty, partly because so much remains to be learned about hormones and partly because the knowledge already gained shows that hormonal action is most complex—the action of one hormone is often dependent on or varies with the action of another; sometimes it may be said that the hormones are almost at cross purposes. For example, the pituitary gland is associated with the sex glands in several respects and it has been credited with the secretion of a large number of hormones—the anterior lobe has been held to develop thirteen and the posterior lobe nine. The differences of opinion that exist may be illustrated by Collip's contention that the anterior lobe of the pituitary gland probably produces no more than three hormones.

The sex hormones have been divided into three groups: androgens, oestrogens and progesterone. The androgens comprise testosterone and such other substances as androsterone and dehydroisoandrosterone; the oestrogens comprise estradiol and its derivatives and may be described as the female sex hormones; progesterone is concerned with the endometrium and the menstrual cycle. It is with the androgens that we propose to deal on this occasion. In most discussions on male sex hormones one of the earliest references to the literature is to the work of A. A. Berthold, who in 1849 declared that the testis produced an internal as well as an external secretion.

James B. Hamilton, however, in a most comprehensive article on the therapeutics of testicular dysfunction, published under the auspices of the Council on Chemistry and Pharmacy of the American Medical Association,¹ points out that Aristotle recognized that the absence of the testis was responsible for the changes observed in castrate animals and man. This is not to be wondered at, for the ancients would have been singularly unobservant if they had not noticed in the eunuchs of the day distinctive qualities other than an inability to procreate. But this is really a digression, and Berthold must be given the credit for discovering that the testis has an internal secretion. Of the known androgens testosterone is the only one that is used widely for clinical purposes. When androgens are used they are used either as substitution products when a deficiency of testicular secretion is known to be present, or as adjuvants when the presence of a testicular deficiency is doubtful or absent. This sounds perfectly simple—when a testicular deficiency is obvious, give hormones; when the patient's condition may possibly be due to such a deficiency, give hormones just the same and note the effect. But it is not such a simple matter, and it is for this reason that this discussion, which may appear to some to be unduly elementary, has been undertaken. Hamilton points out that for a proper appreciation of uses, limitations and dangers of androgens, it is essential to appreciate (a) the relationship between the testis and the pituitary, (b) the sequelæ of castration and eunuchoidism or underdevelopment of the testis, and, conversely, (c) the bodily functions and morphological changes promoted by androgens. It has already been stated that hormonal action is most complex and that the action of one hormone may vary with or be dependent on that of another, and so on. The pituitary gland is given pride of place among the endocrine glands and it is linked up in one way or another with most of them. With the testis the relationship is far from simple. Both the spermatogenic and endocrine functions of the testis are induced and maintained by gonadotropins from the anterior lobe of the pituitary; but it is a sort of push and pull arrangement, for testicular secretions limit the production of gonadotropins by the pituitary gland. Thus, as Hamilton puts it, a loss of testicular function leads to increased secretion of gonadotropins, whereas the administration of exogenous androgens suppresses production of gonadotropic substances. Though it might appear that a determination of the titre of gonadotropin in the urine would indicate whether the atrophy or underdevelopment of the testis was primarily due to lack of secretion by the testis or was secondary to lesions of the pituitary or the brain stem, Hamilton holds that such methods of discrimination in the male are of limited value. The sequelæ of castration and eunuchoidism may be divided into two groups depending on the age of the patient. The sequelæ manifest before puberty are more pronounced than those that appear when the condition occurs after puberty has been reached. The effects of hormone administration are greatest in persons completely castrate before the age of puberty; after puberty the effects vary with the age of the patient and the degree of deficiency. Thus in persons castrate for many years masculinization occurs and many of the

¹ The Journal of the American Medical Association, April 26, 1941.

appearances characteristic of testicular insufficiency are found to disappear. It is not necessary for our present purpose to describe in detail the results of the administration of androgens on the genitalia, the skin, the voice, and so on. What needs to be emphasized is that the testes do not assume normal function, in other words that spermatogenesis is not restored; it must also be remembered that androgen therapy is essentially substitution therapy and must be continued if results are to be maintained.

When we consider the actual indications for the use of these hormones, it will be useful first of all to state the general conclusion that in the present state of knowledge the greatest caution must be exercised. There are three dangers: in the first place no benefit may follow the treatment; secondly, actual harm may be done to the patient if hormones are exhibited unwisely; thirdly, with lack of care useful therapeutic agents may be brought into disrepute and progress in therapeutic science be stayed. Everyone will agree that when bilateral orchidectomy has been performed or when severe eunuchoidism is present sex hormone treatment should be undertaken. Not so simple is the problem presented by boys who do not appear to mature at the usual age. This applies not only to boys suffering from non-descent of the testicle, or as many prefer to call it, delayed testis, but also to those who before the age when puberty would be expected to occur, appear quite normal. The clinician is often hard put to it to know what to do. He knows that in a large proportion of cases all will be well if nothing is done, that development is delayed and nothing more. At the same time the parents of the boy are possibly importunate and the boy himself may be worrying and sometimes to such an extent that he becomes mentally depressed and morbid in his outlook. Hamilton is sound on his discussion of this particular problem. He points out that there is no uniform age for the onset of puberty and that we have as yet no means of differentiating with certainty between those boys who will never mature and those in whom maturation is only delayed. It is possible that if treatment with androgens is undertaken, some of the psychological traumata experienced by the sexually immature may be avoided; but on the other hand "it is debatable whether early acceptance of a need for continued replacement therapy is more comforting than the hope of eventual establishment of normal physiological functions". Endocrine treatment will never encourage the body to assume normal reproductive functions and there is no basis for such a belief. There is a danger that must always be borne in mind, for it has been shown that the temporary use of androgens may result in the early closure of the epiphyses. Hamilton sums the situation up by stating that "the facts now available suggest that there is little gain and that there be harm in the early administration of gonadotropic or androgenic preparations to boys with delayed maturation". When an adult patient complains of sexual disability sex hormones may be helpful. If aspermia is present, spermatogenesis will not be produced. On the other hand, the power of erection will be influenced by androgens, though this power is not dependent on them alone. If impotence is purely of psychic origin, the use of androgens may be the means of restoring the patient's confidence and

thus of effecting a cure. Hypertrophy of the prostate has been reported to be influenced by injected hormones, but here scepticism is justified and much more controlled observation is needed before a pronouncement can be made in regard to it. Finally, apart altogether from sex and its functions, it has been found that androgens give to certain patients who are what may be called prematurely old, a feeling of well-being; they feel as though they had renewed their stores of mental and physical energy. This is safe as long as the patient does not presume on his euphoria and think that he is a second rejuvenated Faust. Hamilton sees here a danger that the patient's euphoria may mask conditions for which he should be receiving treatment. He aptly describes the condition as something like the pouring of new wine into old bottles.

In this discussion, the conclusion of which has already been stated, it may appear that a conservative view has been taken. This has been deliberate. The therapeutic use of sex hormones must be regarded as being still in its infancy. In the time to come, we do not know how soon, research will reveal new methods and new preparations will be isolated. We shall not discover the secret of perpetual youth, but there is no doubt that behind the veil of the future will be found therapeutic weapons of which at present we can only dream.

Current Comment.

ŒSTROGENS IN THE TREATMENT OF DIABETES.

REMARKABLY little general interest seems to have been aroused by the reports from America during recent years of the successful treatment of diabetes in laboratory animals and also in human beings, especially women at the menopause, with œstrogenic compounds. This is as well, perhaps, for now there have appeared other reports from observers in England, who have failed to achieve promising results with the treatment. Among these are F. G. Young, who describes animal experiments,¹ and R. D. Lawrence and Kate Madders, who record clinical experiences.²

The idea of treating diabetes with œstrogens is well founded in theory. It has been shown by Houssay and his collaborators that extirpation of the anterior hypophysis results in a remarkable alleviation of the intensity of the diabetes produced by removal of the pancreas, and it is known that watery extracts of the anterior hypophysis can produce diabetes, at least in dogs. There is some evidence that the diabetes which may develop in women during or after the menopause may be associated with overactivity of the hypophysis, and there is also reason to believe that the secretion of some of the hormones of the anterior hypophysis is inhibited by large doses of œstrogens. It is only a step, therefore, to the suggestion that large doses of œstrogenic substances might alleviate the intensity of diabetes, at least in women at or after the menopause, and the reports claiming to have established this experimentally have been quite numerous. Now that cheap synthetically prepared œstrogens which are active when taken by the mouth have become available, the importance of these matters to diabetics has clearly become very great.

Young, in his experiments on pituitary-diabetic and depancreatized dogs, administered larger doses of œstrogenic substances than previous experimenters, both by the subcutaneous implantation of crystalline hormones and

¹ *The Lancet*, May 10, 1940.

² *Ibidem*.

by oily injections, and he found that they excited either no antidiabetic effect or that they were "pro-diabetic". Lawrence and Madders administered four milligrammes of stilbæstrol daily for eight weeks to five female diabetics, of whom none was enabled to reduce her dosage of insulin, and of whom two needed more after the treatment than before. These results, coming from such sources, will certainly have the effect of tempering enthusiasm with caution. But the subject is one which merits further study; and the conflict of authorities may yet be reconciled, for there have been reports that small doses of the new orally administered oestrogens are often more beneficial than larger doses for the treatment of menopausal symptoms.

THE INTRAPERITONEAL USE OF SULPHANILAMIDE.

The first sulphonamide compound to be used clinically was red "Prontosil", but as this was practically inactive *in vitro* it is not surprising that the local use of this drug was not developed. The discovery that red "Prontosil" was reduced in the body to sulphanilamide and that this drug had a definite bacteriostatic effect *in vitro* on streptococci, naturally led to a trial of sulphanilamide in the treatment of infected wounds. Such local use has since then met with wide approval, especially for the treatment of war injuries; but there has been a slight lag in the application of this form of treatment to infections of the peritoneum.

Before sulphanilamide was used intraperitoneally in man, it was necessary to prove that it was non-irritating to the peritoneum, and that it was effective against peritoneal infections in laboratory animals. S. Rosenberg and N. W. Wall have advocated the local use of sulphanilamide in the peritoneal cavity.¹ They showed that in the rat sulphanilamide was not irritating to the peritoneum; and its intraperitoneal use did afford some degree of protection against experimental infections. These authors reported four cases of peritonitis in all of which recovery followed intraperitoneal implantation of sulphanilamide; but no significant deductions can be made from these cases although all the patients recovered, for it is difficult to imagine that the small doses of sulphanilamide employed (15 to 60 grains) could have produced a bacteriostatic effect throughout the peritoneal cavity. The use of up to 30 grammes of sulphanilamide powder for the local treatment of appendiceal and pelvic abscesses is proposed by L. W. Long and J. G. Dees.² The average dose used by these authors appears to have been 15 grammes. With this amount of sulphanilamide inserted into an appendiceal abscess they found that the sulphanilamide content of the blood rose within twenty-four hours to 1.9 milligrammes *per centum*. After the insertion of a similar dose into the general peritoneal cavity the figure obtained was 15.0 milligrammes *per centum*. There was only one death in their series of 51 cases. They also recommended this treatment for use in all cases of chronic salpingitis and hydrosalpinx, after supravaginal hysterectomy, in cases of tubo-ovarian mass, and following any gastro-intestinal operation in which the peritoneum had been soiled.

From experiments on rabbits R. V. Hudson, R. Smith and F. R. Selbie³ found that while the injection of sulphanilamide into the peritoneal cavity at the same time as contamination with the intestinal contents prevented the development of peritonitis, the administration of sulphanilamide by mouth in one dose of 300 milligrammes per kilogram of body weight at the time of the infection had no effect on the subsequent development of peritonitis.

H. C. Jackson has reported that the absorption of sulphanilamide from the peritoneal cavity is very rapid in the dog.⁴ With therapeutic amounts he found that the blood concentration reached a peak in about two hours and thereafter fell rather rapidly to almost nothing at the end of twenty-four hours. He pointed out that there

appeared to be no other way of administering the drug which raised the blood concentration to effective levels so rapidly, and therefore he suggested that intraperitoneal administration was a valuable method of obtaining an initial saturation which might later be maintained by oral or parenteral medication. This rapidity of absorption, however, is probably a doubtful advantage, for whereas after absorption the drug would again be secreted in the peritoneal fluid in a concentration equivalent to that in the blood, in the vicinity of the unabsorbed powder the concentration might be up to 1,000 milligrammes *per centum*. Since the rate of absorption of sulphanilamide is smaller from a localized abscess, it may be surmised that the effectiveness of this drug would be greater in localized abscesses than in general peritonitis. While the local use of a large amount of sulphanilamide without oral administration may be recommended for the local treatment of localized intraperitoneal abscesses, the local treatment of general peritonitis should almost certainly be reinforced by the oral administration of the drug to prevent the concentration of sulphanilamide in the peritoneal fluid from falling below eight milligrammes *per centum*. Also, in cases of general peritonitis it would seem advisable that, in addition to sulphanilamide, one of the less soluble sulphonamides, either sulphapyridine or sulphathiazole, should be implanted in the peritoneal cavity to prolong the time before the powder disappears.

The bactericidal and even the bacteriostatic action of sulphanilamide in concentrated solutions takes place with only a few organisms. Because of this, the boggy of carrying infection into the body has been raised several times, but the defences of the body should be able to deal with the few organisms living on powdered sulphanilamide. Sulphanilamide is without effect on the tetanus bacillus, but the possibility that sulphanilamide powder may contain tetanus spores must be very remote, although it cannot be completely ignored. This problem is not solved by autoclaving the powder, for according to Long and Dees this breaks sulphanilamide up into its chemical components and renders it inactive, thus achieving sterility while the drug is destroyed. For the surgeon's peace of mind, and perhaps for that of the patient, it would be preferable, if it were possible, to sterilize sulphanilamide, but no case has yet been reported in which infection was introduced with sulphanilamide, and it would be a pity if this possibility inhibited the development of the intraperitoneal use of the drug.

A DEATH FROM TRANSFUSION OF PLASMA.

In view of the prominence given to blood transfusion it is important to know that a death after transfusion of plasma is recorded by Frank Mayner.¹ The patient was a boy, aged four years, who suffered from nephritis. The treatment included transfusion of 250 mls of citrated whole blood from the father; the condition improved and the child was sent home. After 56 days he was readmitted to hospital with an aggravation of the kidney condition. In order to increase the plasma protein it was decided to give the child a transfusion of the father's plasma. When nearly 100 mls had been given the patient suddenly became cyanotic and dyspnoeic and died. Autopsy revealed multiple emboli of fibrin in the terminal pulmonary vessels and capillaries and subacute glomerular nephritis. The cause of death was anoxæmia caused by the capillary emboli of fibrin. Mayner sees two possible causes for the fatality. The first is faulty preparation and administration of the plasma. The second is the use of the same donor twice. Gutteridge has written of this "same donor" reaction in this journal in April, 1940 (Mayner mentions this). Safety appears to lie in the acceptance of the "cardinal rule" stated by Bonnin in this journal (June 17, 1939), that no patient should ever receive a second transfusion from the same donor. Bonnin stated that "same donor" reactions after blood transfusion might be hæmolytic or allergic.

¹ *Surgery, Gynecology and Obstetrics*, March, 1941, page 568.

² *Surgery*, June, 1941, page 878.

³ *The Lancet*, April 5, 1941, page 438.

⁴ *Annals of Surgery*, June, 1941, page 1063.

¹ *The Journal of the American Medical Association*, May 3, 1941.

Abstracts from Medical Literature.

PÆDIATRICS.

Röntgenography in Congenital Pyloric Stenosis.

JOSEPH K. CALVIN AND EDWARD J. DENENHOLZ (*Archives of Pediatrics*, January, 1941) point out that although there is general agreement that a diagnosis of pyloric stenosis should be made if the pathognomonic pyloric tumour can be felt, considerable discussion exists as to the relative number of cases of pyloric stenosis in which the tumour is palpable. In cases of suspected pyloric stenosis in infants the important decision to make as early as possible is whether the infant has the type of true stenosis requiring surgery in contradistinction to an obstruction consisting mainly of spasm and not requiring surgery. If a pyloric tumour could be palpated in every case of pyloric stenosis there would be no need for further discussion of diagnostic aids. When a pyloric tumour is felt beyond question, the decision is not difficult to make. In the experience of the authors this sign in the individual case may not be present early and the diagnosis may be a problem requiring considerable clinical experience and judgement. X-ray examination then assumes increasing importance. The conflicting opinions in the literature reviewed by the authors concerning the relative value of palpation of the pyloric tumour and of X-ray examination stimulated them to investigate these problems critically in cases studied at their institution. This investigation indicates that the diagnosis of pyloric stenosis and its differentiation from severe pyloric spasm may be difficult. Palpation of the pyloric tumour is of first importance in the diagnosis, and repeated and painstaking effort should be made to elicit this pathognomonic sign. When the tumour is unmistakably palpable X-ray examination is not essential, and if used is merely confirmatory. X-ray examination should not supersede palpation of the tumour; but the authors state that it seems evident that palpation of the pyloric tumour may vary with different clinicians and different clinics. There are definite instances in which X-ray examination may offer real aid in the diagnosis—for example, for the physician in general practice whose experience with pyloric stenosis may not be great and who may have difficulty and uncertainty in feeling the tumour. Secondly, even experienced physicians may at times find the tumour difficult or impossible to feel, as in some cases in which the tumour may be circled up under the liver or rotated behind the stomach. X-ray examination is also of inestimable value in those cases in which the clinical history suggests pyloric stenosis but in which the X-ray findings indicate that no obstruction is present. The authors conclude that this valuable method of examination is not being sufficiently utilized, even being ignored, dismissed as being useless or relegated to an insignificant diagnostic role. The diagnostic feature of the X-ray examination is the relative amount of barium which remains in the stomach and the

amount which is passed into the small bowel after four hours. In a typical case of organic pyloric stenosis the stomach will show residual retention at four hours of 60% to 100% of the barium meal. A case in which the pyloric obstruction consists mainly or entirely of spasm may show no retention or at most 40%.

Acute Endocarditis in Infants.

REMARKING that according to the literature acute endocarditis is a rare disease in infants, S. Wolff (*The British Journal of Children's Diseases*, October-December, 1940) reports two cases occurring in infants, aged respectively three and a half and three months, both of whom recovered. Both infections originated from apparently harmless boils, and both were due to staphylococci. The author refers to a "triad" described by Orgler and by Finkelstein—pallor of the face, attacks of cyanosis and accelerated respiration, for which no other cause can be discovered—and adds that, thanks to this description, the diagnosis was made without difficulty. In the second case the endocardial condition was complicated by purulent pericarditis. The author lays stress on the fact that the heart, though gravely affected, may become quite normal again after cure of the endocarditis. He also insists that as in both his cases the staphylococci originated from furuncles at the back of the head, the greatest attention should be paid to even small boils in an infant and to their early evacuation.

The Thyroid Gland in Juvenile Diabetes.

M. M. STEINER AND A. L. NEWCOMB (*American Journal of Diseases of Children*, March, 1941) discuss the enlargement of the thyroid gland in juvenile patients suffering from *diabetes mellitus*. They give details of two cases to show that the association of hyperthyroidism with juvenile *diabetes mellitus* brings about a striking change in the diabetic state. They have also investigated the relationship of a palpable thyroid in juvenile patients suffering from diabetes to family incidence of diabetes and thyroid disease. Of 128 juvenile diabetics, 26 had a palpable thyroid gland and 102 a normal gland, 33 had a history of diabetes in the family and 34 a history of thyroid disease in the family. Of the 26 subjects with a palpable thyroid gland, 13 had a family history of diabetes, as compared with 20 of the 102 who had a normal gland. Of the 26 subjects with a palpable thyroid gland, 21 had families in which there was a history of thyroid disease, as compared with 13 of the 102 who had a normal thyroid gland. It has been suggested that hyperthyroidism may be one of the factors predisposing to the development of diabetes. When enlargement of the thyroid is present in a diabetic subject the enlargement does not influence either the onset or the course of the diabetic condition unless hyperthyroidism occurs. The authors review some of the work that has been done on the relation of the action of the thyroid gland to sugar metabolism. Althausen showed that the administration of thyroxine to rats accelerates the absorption of utilizable sugars from the intestine; conversely, thyroidectomy slows the absorption of dextrose from the intestine. The increased absorption of carbohydrate in hyperthyroidism accounts for the "diabetic" manifesta-

tions of glycosuria, post-prandial hyperglycaemia and high dextrose tolerance curves. The increased utilization of carbohydrate also accounts for the normal or greater than normal arteriovenous blood sugar difference, the post-prandial rise in the respiratory quotient and the fall in the level of the inorganic phosphates in the blood. To illustrate the effect of hyperthyroidism on carbohydrate metabolism the authors give details of the history of a ten-year-old girl who suffered from hyperthyroidism and who also had a family history of diabetes and manifested glycosuria, hyperglycaemia and impaired tolerance for dextrose and galactose. They give full details of the clinical investigations carried out in this case. They state that although *diabetes mellitus* may eventually develop in this patient because of the family tendency, the elimination of the hyperthyroidism may lessen the chance of this development. The authors conclude with a discussion on the differentiation of diabetes and hyperthyroidism.

Encephalitis Complicating Measles.

P. M. HAMILTON AND R. J. HANNA (*American Journal of Diseases of Children*, March, 1941) review 241 cases of encephalitis following measles collected from the literature and 44 additional cases observed by themselves. When the central nervous system is attacked in measles the resulting clinical picture is chiefly characterized by variability. The results of physical examination and of laboratory tests are so bizarre and inconstant that in regard to them one case has little in common with another. The only specific common denominator is that all results indicate involvement of the central nervous system. The terminology has become confused because the widely varying clinical picture tends to encourage nomenclature descriptive of individual observations. The incidence of encephalitis with measles is not known; Hoyne found that the estimate of one case per thousand of measles was correct in Chicago in 1938; but the authors state that in their experience the figure should be somewhat higher. For the onset of encephalitis to occur before the appearance of the rash is rare; it preceded the rash in 16 of the cases collected by the authors from the literature and in one of their own series. The average time that elapsed after the appearance of the rash before the onset of the encephalitic symptoms in the authors' cases was two and seven-tenths days; in the cases reviewed it was five and two-tenths days. The symptoms vary greatly according to the severity of involvement and the portion of the nervous system most severely attacked. Fever is usually, though not invariably present; sometimes the temperature is very high. The duration of the fever is not consistently related to other factors. Changes in the sensorium almost always occur; they are usually indicated by torpor and lethargy, but occasionally by restlessness, excitement and disorientation. The authors have set out in a table an analysis of the symptoms occurring in the 285 cases of the whole series. In another table are the results of neurological examination; they are "varied and bizarre". The commonest single sign is stiffness of the neck, and the one next most frequently seen is Kernig's sign. The average leucocyte count in 43 of the reviewed cases and in those of the authors' own series was 16,130 cells

per cubic millimetre, with 80% polymorphonuclear cells. In regard to prognosis, complete recovery occurs in 40% of cases, recovery with residual symptoms of greater or lesser severity occurs in 40% of cases, and death in 20%. Therapy is unsatisfactory. The most successful results were obtained by the authors with shock therapy.

ORTHOPÆDIC SURGERY.

The Slipping-Rib-Cartilage Syndrome.

JOHN F. HOLMES (*The New England Journal of Medicine*, May 29, 1941) calls attention to an abnormal mobility and deformity of the anterior ends of the lower costal cartilages causing painful symptoms. The syndrome affects the anterior ends of the rib cartilages and the interchondral articulations, and concerns the eighth, ninth and tenth rib cartilages only. Slipping rib cartilage is of fairly common occurrence, and often produces irksome incapacitating symptoms. It is diagnosed by physical examination and is cured by simple operation. Needless laparotomies have been performed because of failure to recognize the syndrome. The deformity involves the costo-chondral cartilages of the lower ribs, notably the eighth, ninth and tenth, either by displacement of fracture fragments or dislocation of the cartilage, or more often by curling of the end of the loosened cartilage. On respiration the deformed end slips or rubs against the side of the rib above with a click and in some cases with severe pain to the patient. Abnormal mobility of the ends of the rib cartilages may begin acutely from fracture or dislocation of the cartilage, or more often as a partial separation of the fibrous attachment. Multiple injuries which stretch the fibrous attachments over a period of time, as those caused by golf or one-sided weight carrying, may be responsible. Diagnosis is made from complaint of pain in the rib border and by digital palpation; by palpation the click on respiration can be appreciated when the patient is supine and has the knees flexed. Some patients have recovered with conservative treatment by adhesive strapping. In eight cases the affected rib cartilage or cartilages were excised and immediate and permanent cure followed.

Simple Exostectomy for Bunions.

ROBERT F. McELVENNY and FREDERICK R. THOMPSON (*The Journal of Bone and Joint Surgery*, October, 1940) have studied the results of exostectomy for the relief of bunion pain. The procedure is to remove the projecting medial portion of the first metatarsal head. It does not correct the *hallux valgus*. From a study of skiagrams taken on patients suffering from *hallux valgus* several conclusions were drawn: (i) The size of the exposed medial portion of the first metatarsal head is in direct proportion to the degree of great toe valgus. (ii) The amount of new bone present, which changes the shape or enlarges the metatarsal head, rarely exceeds one-sixteenth of an inch in thickness. (iii) Areas of fibrocytic degeneration are present in many cases. One hundred patients were operated upon. The youngest was fourteen

years and the oldest sixty-nine years of age. Local or general anesthesia was used. The bursal sac was excised only if it contained calcareous material. The amount of bone to be removed was determined by observation of the line separating non-articular from articular cartilage. The authors refer to the possibility of splitting the shaft of the metatarsal, and state that it is necessary not to leave any sharp spicule of bone which may later cause pain when pressed on by the shoe. After suture of the wound in layers, the toe is bandaged so that it may be held towards a varus position and in slight plantar flexion. Active toe movement is encouraged. Seventy-seven of the one hundred patients were entirely relieved of all bunion pain. The majority of the patients returned to work seven weeks after operation. In the remaining twelve cases the results were disappointing. Eleven of the twelve patients had both feet operated upon. The writers consider that the cause of the subsequent pain was a faulty selection of patients or some fault in operative technique. Patients subjected to the operation should fulfil the following requirements: (a) The patient should be concerned chiefly with the relief of pain and not correction of the deformity. (b) Circulation in the feet must be adequate. (c) Sesamoiditis should not be present. (d) Movement at the first metatarsophalangeal joint should be free and painless. (e) The angle of the valgus should be under 50° and the anatomical relationship between the great toe and second toe must be normal. Operative faults include failure to remove a loose bone spicule, too generous a removal of the medial side of the metatarsal head, and the leaving of a sharp medio-plantar border on the metatarsal head.

Malunion of Fracture of the Metacarpal Head.

EDWARD J. HABOUSH (*The Journal of Bone and Joint Surgery*, October, 1940) describes an operation to restore function in malunited fractures of the head of the metacarpal bones ("knuckle fracture"). The metacarpophalangeal joint has no true capsule, but is invested by a tube of synovial membrane which lines the volar and the two collateral ligaments. Proximally the synovial membrane forms a dorsal and a volar fold, which cloak the metacarpal neck and extend for about one inch. On the dorsal aspect the extensor expansion is permitted a wide excursion of movement. In knuckle fractures, produced experimentally in cadavers, the dorsal extensor tendon displayed evidence of trauma, the synovial roof was intact in some cases, and in others one to three rents were found. Invariably on the dorsal aspect the fracture was within the joint, whereas on the volar aspect the oblique fracture line was cloaked by synovial membrane. The distal fragment was displaced into the palm and towards the wrist. The fifth metacarpal is more susceptible to trauma than the second, third or fourth. Flexion at the fifth metacarpophalangeal joint is greater than that at the other three metacarpophalangeal joints. In a series of two hundred knuckle fractures, 120 involved the fifth, 20 the fourth, 16 the third, and 44 the second. In the operation carried out by the author the fifth finger was affected, the head of the fifth metacarpal being displaced forwards and towards the fourth finger. The arc of movement of the metacarpophalangeal joint was limited to 10°.

The patient complained of weakness of the hand. A longitudinal incision was made over the dorso-medial aspect of the joint. The dorsal extensor tendon was found adherent to a dense fibrous tissue mass, which in turn was fixed to the metacarpal bone, obliterating the dorsal synovial fold. The fibrous tissue mass was a bar to flexion of the joint. The metacarpal head was hidden by a ridge of bone projecting dorsally. This ridge was levelled with an osteotome. No attempt was made to correct the alignment of the head. The wound was closed and the finger placed at a right angle with the metacarpal. Movement was commenced in four days. In six weeks complete range of movement and full function were restored.

Amputations of the Lower Extremity.

W. E. GALLIE (*Annals of Surgery*, June, 1941) records the opinion of a succession of surgeons associated with the Canadian Army and Pensions Board on amputations of the lower extremity. The conclusions are based on experience with 2,448 amputations. The four principal amputations—the Syme, the mid-calf, the Gritti-Stokes and the mid-thigh—are considered. A good Syme is considered the best of all amputations. The points in favour are, first, that the patient can walk on the stump for short distances without the trouble of applying the artificial limb, and second, when fitted with a good artificial limb he can walk or run as well as remain on his feet all day long. It is admitted that the Syme artificial limb is unsightly, but in the case of a man this is covered by the trousers. The objection is so important in the case of women that the operation should not be recommended. The operation must be done well. The flaps must be cut to avoid redundant tissue, so that the heel flap can be firmly fixed on the end of the severed tibia and fibula. Great care must be taken when dressings are applied to ensure that this latter flap is not displaced. The operation has no place when there is any possibility of infection, or in limbs in which the circulation in the flaps may be impaired. Of amputations between the ankle and knee there is little to be stated that is favourable. Coldness and blueness of the stump, "pain in the foot", ulceration in the scar and blisters on the weight-bearing area are common complaints. The stumps are unable to stand up under the strain of a day's work, because the patient's weight must be borne on the sides of the stump, on areas unaccustomed to weight bearing. Important rules to be observed in the operation are: the stump should never be more than six inches long; the fibula must be cut short or removed, and the skin should fit the end of the stump neither loosely nor tightly, lying on muscles that have retracted to or slightly above the level of bone section. In spite of all care, however, the operation is considered unsatisfactory, and it is the practice of the Canadian Pensions Department to convert troublesome below-knee amputations into the Gritti-Stokes type of end-bearing-above-knee limb. Comparison of the Gritti-Stokes amputation with amputations in the mid-thigh is in favour of the former. The end-bearing stump permits of a solid grip on the ground and better walking. Also a stump socket of the corset variety permits greater freedom of the hip than when the weight is borne on the ischium.

Medical Societies.

MELBOURNE PÆDIATRIC SOCIETY.

A MEETING of the Melbourne Pædiatric Society was held on June 11, 1941, at the Children's Hospital, Melbourne. Dr. H. L. STOKES, the President, in the chair. The meeting took the form of a series of clinical demonstrations by some of the members.

Cretinism Associated with Anomalous Hip Joints.

Dr. L. P. WAIT showed a female baby, aged five months, who was undergoing treatment for cretinism. She was the fourth child in the family; the older ones respectively were aged six years, four years and two years, and all three of them were healthy. The baby shown by Dr. Wait came into his care at the hospital a month earlier. In addition to the presence of an umbilical hernia, which was the main complaint by the parent, it was noted that the child's tongue was large and protruding. When questioned, the mother said that the child's tongue had always been prominent and that the baby had not had a normal bowel action, some form of aperient having been necessary from birth. The baby was fed on breast milk and had gained weight steadily. At that time she weighed twelve pounds five and three-quarter ounces, having gained a little over four pounds in the first four months. The mother had not noticed that the baby was backward mentally. The baby had the typical cretin facies; the anterior fontanelle was widely open, the tongue was large and protruding, but not fissured, the hair was long and dry, an internal strabismus of the left eye was present, the abdomen was protuberant, the recti were widely separated, and a very large umbilical hernia was present; there was no padding of the supraclavicular fat, and no other abnormalities were noted at that time.

Dr. Wait said that he had prescribed thyroloid (fresh gland) and had advised the use of one tablet (one-quarter of a grain) per day for three days and then two tablets per day. He said that although he proposed steadily to increase the amount of thyroloid medication, he had not proceeded further at the time of the meeting; but already the child had become brighter and was able to have bowel actions without aperients. He then said that he had obtained skiagrams of the pelvis and knees in view of the interesting information on epiphyseal dysgenesis sometimes encountered in cretinism, to which the attention of the members of the society had been directed by Dr. H. J. Sinn at the meeting in May, 1940 (THE MEDICAL JOURNAL OF AUSTRALIA, November 9, 1940, page 478). In the films it was obvious that the epiphyseal centres around the knee joint normally present at that age could be visualized, but there were certain anomalous appearances in the films of the pelvis and hip joints which were the subject of some differences of opinion. The acetabular development was poor, particularly on the right side, and Dr. A. Gwynne Villiers had reported that she was of the opinion that bilateral congenital dislocation of the hips was present. Because of that report, Dr. Wait said that he had consulted Dr. Wilfred Forster, who would comment on that aspect of the case.

Dr. WILFRED FORSTER said that when he had first seen the patient it had already been suggested that double congenital dislocation at the hip joints was present. It was always difficult to diagnose that condition before a baby was old enough to walk. The diagnosis was fairly easy in single dislocation, as one leg would not be used as well as the other. Moreover, there was usually an increased number of folds in the skin of the inner side of the thigh, and when the two feet were placed level on the bed with the knees flexed the knee on the side of the dislocated hip would be slightly lower than the other; and often limitation of abduction on the affected side was found as well. But when the dislocation was bilateral and the baby was very young, none of those diagnostic points could be made, though one might suspect the presence of bilateral limitation of abduction. From the radiological point of view there were also difficulties in the early months of life; but there were some small indications that he had found helpful, reference to which might be of interest to the members. The femoral capital epiphysis was usually much less well developed, and from the outline of the outer lip and roof of the acetabulum it could be shown that the acetabulum too was relatively underdeveloped. If a vertical line was dropped from the outer lip of the acetabulum and a transverse line at right angles to it was drawn, cutting through the centre of the triradiate cartilage, the epiphysis should be in the inner and lower quadrant when the head was not dislocated.

Dr. Forster doubted the correctness of the diagnosis made on radiological grounds in the case under discussion; but the child had no doubt limitation of abduction. Dr. Forster asked Dr. Villiers to give reasons for the diagnosis, and hoped that she would reconsider the position. Dr. Forster said that he had adopted treatment on an abduction splint, which he had found to be extremely useful; as the baby kicked one leg, the head of the other femur was pushed against the acetabulum.

Dr. A. GWYNNE VILLIERS said that Dr. Forster had put forward grounds on which he admitted that the diagnosis was extremely difficult, and Dr. Villiers had noticed at previous meetings that the radiological criteria necessary for the diagnosis of double congenital dislocation in early infancy were debatable. When the subject was complicated by cretinism with ill development of the acetabulum and absence of the outline of the femoral capital epiphysis on each side, it became apparent that there were serious radiological difficulties as well as clinical ones. At the same time she was satisfied that usually, even at four months of age, the upper shelf was well developed and to a greater extent than in the present case; and according to her diagrams the epiphyses, if they were considered to be present visually, would be outside the limits she was in the habit of setting. A further complication was that when the skiagrams were being taken the limbs of a baby had to be held down forcibly by an assistant; that made it difficult to obtain strictly comparable outlines. Dr. Villiers asked for other expressions of opinion from members concerning early diagnosis.

Dr. H. DOUGLAS STEPHENS said that congenital dislocation of the hip in the early stages should be considered under the headings of complete and incomplete dislocation (subluxation). There should be no doubt of the diagnosis in the complete type, and subluxation could be said to be present when the head of the bone was further away from the triradiate fissure than usual. The latter point was difficult to establish in certain cases, which included the one under discussion. The clinical observation he had found of assistance was a tendency to flexion at the knee joint even after the leg had been forced down. When one leg only was affected the difference from the other leg might make the anomaly apparent; but when both were in question it was at times extremely difficult to diagnose subluxation with confidence. In view of the cretinism and the sloping acetabula, the legs of the patient under discussion should be abducted; cretins were apt to develop the so-called "Hottentot" pelvis.

Treated Cretinism.

Dr. Forster then showed a little girl, aged approximately four years, who had come under his notice because of the presence of a huge hemangioma on the forehead. He said that he thought members would be interested to see her as an example of treated cretinism. Some two years before she had been shown at a meeting of the society, and at that time the appearances were characteristic of cretinism and she was having thyroloid medication. It had been noticed that the tongue was too big for the mouth, that the child was too well-behaved, sitting quietly all day long, that she had a large umbilical hernia, that the hair was like a wig and when pulled out came away easily and appeared to be dead, and that particularly large supraclavicular pads were present. Her condition had improved greatly, and the daily amount of thyroloid gland she was taking was the equivalent of three grains of *Thyroidea Sicca*. The umbilical hernia had practically closed without operative repair, the general appearance was distinctly better, and though mentally she was below normal, temperamentally she was quite bright.

Pulmonary Hydatid Cyst.

Dr. J. G. WHITAKER showed again a boy with a single hydatid cyst in the right lung, reports of whose case had appeared in THE MEDICAL JOURNAL OF AUSTRALIA on February 22, 1941 (page 252), and on March 22, 1941 (page 370). Dr. Whitaker said that after he had taken over the care of the boy from Dr. Emberton, and while the child was in the surgical ward, spontaneous rupture of the cyst had occurred. The child was noticed to be white, suffering from shock and desperately ill; but he had not coughed up any recognized portions of the cyst membrane. A level of fluid was seen next day on the fluoroscopic screen. The patient had recovered without operative interference, and from a series of skiagrams Dr. Whitaker showed that the lung appeared to have become restored to normality. It was apparent to the members that the boy was strong and well.

In commenting on the case, Dr. Whitaker said that Professor Dew, in his writings, had given varying figures for the frequency of spontaneous cure, and certain other authorities had held that between 60% and 80% of pul-

monary hydatid cysts were cured spontaneously. It was certain that many patients would not reach either a surgeon or a physician. Dr. Whitaker had himself had previous experience of spontaneous rupture and cure. The rupture produced a hole which had to be filled by expansion of the lung much in the same way as that following a surgical operation.

Dr. Whitaker showed various skiagrams of a girl; in these the appearances of ruptured pulmonary hydatid cyst were seen, and by means of iodized oil the presence of a sacculatation cavity was revealed. Clinically the child had appeared to recover, but Dr. Whitaker had not followed her progress for long afterwards.

Dr. Whitaker said that in view of the evidence he had given he had become a little conservative in treatment and felt justified in the hope of cure without operation. The operation was not devoid of risk; but the same applied to spontaneous rupture of a cyst. He added that the Casoni intradermal test produced a reaction in the case of the boy under discussion when he came to the surgical ward and before rupture of the cyst; but the hydatid complement fixation test had not been carried out recently.

Dr. DOUGLAS STEPHENS wondered when it was possible to say that a ruptured pulmonary hydatid cyst was safe from infection and spread of infestation. He recalled the case of a patient with two cysts; five weeks after he had operated on one of them the patient had coughed up blood and fluid, but not "grape skins". From the skiagrams it was obvious that the second cyst had ruptured; but there were some shadows that suggested that the endocyst was still there and perhaps contained some fluid. Dr. Stephens thought that the boy shown by Dr. Whitaker could be expected to cure himself; but it was of interest to conjecture what would happen if he did not expectorate the endocyst, which seemed to be a potent source of further cysts or of lung abscess.

Dr. Forster mentioned a case in which at operation he had come upon a number of daughter cysts and much membrane; three or four years later the patient had had trouble from a cyst in the right iliac region. Dr. Forster was unable to say whether it was part of the original sowing or the result of spilling of material at operation.

Dr. KEITH HALLAM said that he had seen the remote effects of spontaneous rupture, and he thought that Dr. Whitaker was altogether too modest when he inferred that operative treatment and Nature's cure were all the same to the patient. He referred in particular to two cases. One was that of a middle-aged man with hæmorrhages from the chest; some twenty-six years earlier he had had a spontaneous "cure" of a pulmonary hydatid cyst. Dr. Hallam had been able to show radiographically, with the use of iodized oil, that there was a small cavity in the lower lobe of the lung, and lobectomy was performed. The other case was that of a patient in his care in 1924. She had coughed up much fluid and hydatid material, and the diagnosis had been confirmed at the Royal Melbourne Hospital. Dr. Hallam had heard only recently that she had been suffering from a residual abscess, seventeen years after the rupture of the original hydatid cyst.

Dr. BRUCE HALLOWES said that he had in his care a patient with hepato-pulmono-bronchial fistula, who had had since 1934 to relieve herself of the offensive discharges by tipping herself upside down. The patient was almost seventy years of age, and she had lost about ten pounds in weight, no doubt owing to difficulty in digestion of her food on account of damage to the liver from the original hydatid infestation.

Dr. Whitaker, in reply, said that he had no doubt that there were recurrences both after spontaneous rupture and after operation, and he asked members able to do so to show relevant patients, especially after recurrence following rupture; the endocyst died when rupture occurred and was harmless from the reproductive aspect; but there was a grave risk of trouble from sepsis. Both procedures probably had their risks, for he had known infection to have followed operation.

Acute Hodgkin's Disease.

Dr. Whitaker also showed a little boy, aged eighteen months, with oedema of the face, which had developed ten days earlier. He came from a country town in which mumps was rampant, and the enlargement of the face had been gradual. He had been at the Children's Hospital for five days; the oedema had extended into the scalp, and on the thoracic wall and abdomen there were networks of varices. The temperature was intermittently elevated diurnally, and mediastinal enlargement was shown in skiagrams, though it could not be certain that it was due to glandular hypertrophy. Dr. Whitaker said he thought that a little brawniness was present in the mastoid area on

the left side of the head, and mentioned that lymph glands were palpable in the axillæ. The oedema appeared to be of inflammatory origin, and it was possible that some pus was present in the deep planes of the neck; or the condition might be due to blockage of the deep veins by a rapidly growing tumour or to acute mediastinitis. Apart from a small sore which was present on the face at the onset, no skin foci of infection were present.

Dr. Forster said that tumour or infection of the mediastinum had been mentioned in the differential diagnosis, but as the condition had marched ahead very rapidly, he thought that tumour could be excluded. He remarked that the pressure seemed to be almost entirely on the venous system; but if the pressure was sufficient to produce varices and oedema, he would have expected evidences of pressure on the œsophagus too; but these were not forthcoming. He had been wondering whether thrombosis of the left innominate vein was a possible diagnosis.

Dr. Stephens said that he was afraid he could throw no light on the diagnosis. From the rapidity of progress, the inflammatory signs of high fever and the appearances in the skiagrams, he thought a mediastinal abscess might be present; there might have been a traumatic injury of the chest, the limbs escaping, and the face, scalp and chest being affected. The surgical approach should be through the sternum.

Dr. Whitaker, in reply, said that he was grateful for the suggestions that had been made. If the child's condition warranted it, he would probably incise the submaxillary region of the left side or insert needles on each side of the sternum; he thought there was deep suppuration somewhere, and he would try to locate it and then follow the pus.

[This child died on June 23, twelve days after the meeting, and an autopsy was made, with the following findings. The body was that of a small infant, and post-mortem staining was present. The deep cervical glands and the mediastinal, tracheo-bronchial and hilar lymph glands were considerably enlarged; the majority were one or two centimetres long and half to one and a half centimetres thick. The glands were matted together, and the surrounding tissue, including the thymus gland, was involved in cellulitis, which had not progressed to the stage of suppuration. Examination of sections of the lymph glands revealed a fleshy structure, with an extreme degree of oedema and hyperæmia, but no necrosis, caseation or suppuration.

The large veins and arteries of the mediastinum were not thrombosed, and the trachea was not compressed. The veins over the mediastinal portion of the pleura were considerably swollen and enlarged. Both pleural sacs contained approximately five ounces of straw-coloured, faintly turbid fluid. Both lungs were partially collapsed, the right lung more than the left. The right lung contained comparatively little air, and section disclosed the typical picture of collapse; but no pneumonic consolidation was present. The left lung presented a similar picture, but there was considerably more air-containing tissue. A few fibrous adhesions were found between the posterior surface of the lower lobe of the left lung and the paravertebral sulcus.

The pericardial sac contained two ounces of clear straw-coloured fluid; but no pericarditis was present. The heart was of normal size, the muscle was pale but firm, and the endocardium and valves appeared normal. No congenital malformation was present. The fatty tissue surrounding the atrio-ventricular sulcus and the auricles was firm, congested and oedematous.

Examination of the abdominal cavity revealed an extension of the mediastinal cellulitis and glandular enlargement down the para-aortic lymph glands and the lymph glands of the enteric mesentery. These glands were not so much enlarged as those of the mediastinum, the dimensions of the majority being 1.5 centimetres by 1.0 centimetre; but they presented the same pathological features—a fleshy appearance with considerable congestion and oedema. There was no excess of peritoneal fluid and no peritonitis was present. The gastrointestinal tract appeared normal, apart from a small Meckel's diverticulum situated two and a half feet above the ileo-caecal junction. The kidneys, apart from some congestion, appeared normal. The spleen was of normal size; no perisplenitis was present, and the pulp was normal. The liver, suprarenal glands and pancreas appeared normal.

Portions of the thymus and the mediastinal and mesenteric lymph glands were removed for histological examination. Disorganized structure, largely due to endothelial cell proliferation, was found in a lymph gland from the mediastinum and from the enteric mesentery. These large endothelial cells, together with fibroblasts, large mononuclear cells, eosinophilic cells and multinucleated cells of a Sternberg type replaced most of the lymphocytes of the gland. This pleomorphic cell picture, the hyperæmia of the blood vessels, and the increase of fibrous tissue in both the gland substance and the capsule, suggested an inflammatory lesion closely

resembling acute Hodgkin's disease. Histological examination of the thymus revealed a similar inflammatory reaction.

The comment was made that the clinical course of the illness, which commenced with enlargement of cervical glands and then spread to the mediastinum, together with the pathological appearance of extensive, diffuse, subacute, non-suppurating lymphadenitis and cellulitis of the neck, mediastinum and enteric mesentery, and the histological appearance of the glands, best fitted a diagnosis of acute Hodgkin's disease. On two occasions unsuccessful attempts were made to grow on nutrient media organisms from the inflammatory exudate into the pleural cavities; this fact indicated that the causative agent of the lesion was not one of the ordinary known bacteria. The cause of death was considered to be acute Hodgkin's disease.]

Ambulatory Splint for Paralysed Shoulder Muscles.

DR. JEAN MACNAMARA showed a group of children to illustrate the use of an ambulatory splint for paralysed shoulder muscles. She said that almost four years had elapsed since the commencement of the large epidemic of poliomyelitis, and many of the persons affected were no longer handicapped; but there were a number in whose cases it was obvious that return of function in one or both upper limbs was unlikely to occur. That group of patients presented a problem—what to do with the flail arm and how to help the patient to carry it around, keeping it warm and safe without causing deformity of the trunk. She said that some people considered amputation was the solution; but it was her feeling that the decision to have an amputation performed should be made when the patient reached adult age, had chosen his occupation, and could judge whether the handicap of the arm outweighed any use it might have, even if it could be used only as a paper weight.

Dr. Macnamara then showed three children to demonstrate the use of leather jackets with extensions for the upper limb modified to make artificial use of the elbow joint.

A boy, aged ten years, had contracted poliomyelitis in 1934; the left arm was severely paralysed and little recovery of power had occurred. Dr. Macnamara commented that after some years it had become obvious that nothing further could be gained by keeping the limb on an abduction splint, and the risk of scoliosis had to be considered. As the boy was growing rapidly, it was not thought advisable to keep the arm in a sling, which tended to cause bad posture; yet the flail arm was in danger when hanging by the side. She had decided therefore to have made a leather mould of the upper part of the chest, with an extension for the left arm to hold the arm in the position most favourable for keeping the head of the humerus against the glenoid cavity. By the provision of a moulded leather splint attached to the arm the child had something on which objects could be rested. Dr. Macnamara said that recently he had grown out of the splint and another was being made with a larger surface of purchase on the trunk, and added that he found the arm and hand of some use.

Another patient, a girl, who had contracted poliomyelitis in August, 1937, at the age of six years, had weakness of the neck, trunk and right thigh, and almost a flail condition of the left arm. In June, 1938, a flicker in the triceps was detected, and she was able to flex the left wrist against gravity. Dr. Macnamara said that the child was fitted with an abduction splint in December, 1938, but that in February, 1940, some anxiety about her back was recorded, and in July, 1940, it was noted that the condition of the left shoulder and elbow appeared to be hopeless and the abduction splint was increasing her scoliosis; it was decided, therefore, to let her carry the arm in a sling and to have a plaster mould made for the fingers. After she had worn the sling for a few weeks the neck assumed a faulty position and kyphosis developed in the upper thoracic region. Dr. Macnamara went on to say that in October, 1940, the patient was fitted with the splint which she was wearing at the meeting, but that as the forearm had grown in length, the splint had been adjusted recently. The splint was popular, because the weight of the arm was carried from the pelvis and it looked better under her clothing; the arm felt safer, but was of a certain amount of use to the child.

The other child shown by Dr. Macnamara was a boy, who had contracted poliomyelitis in October, 1937, when nearly six years of age. At the onset he had had paralysis of the left facial muscles, gross paralysis of both arms (the left being more severely affected than the right), and moderate weakness of the legs and trunk. When the legs had recovered, the problem of holding him erect had had to be faced. He was fitted with a jacket with extension for the arm and support for the head; the forearm and wrists had leather wrist supports linked to the arm by rubber tubing passed over pulleys, which caused flexion at the elbow joints.

Dr. Macnamara demonstrated the efficacy of the splints and the obvious pride and happiness of the children by encouraging them to mingle freely with the members and to show them how the devices worked. Before finishing her demonstration, Dr. Macnamara expressed indebtedness to Mr. Masson, the head splint maker at the Children's Hospital, for the interest and enthusiasm he had shown in the making of the splints, and also to the members of the staff of the physical therapy department, who had made the plaster casts.

DR. H. L. STOKES thanked Dr. Macnamara for the demonstration and remarked that the splint was most ingenious and beautifully made.

DR. ELIZABETH MCCOMAS said that she had in her care several patients with similar weakness of the shoulders and arms, and she had been wondering how she could make them more comfortable. She had been using the sling method; but when the arms were allowed to swing there was a tendency to dislocation at the shoulders. The demonstration had impressed her, and she intended to try to apply the lesson for the benefit of her patients, as the new splint would be an answer to some of the problems.

Dr. Macnamara, in reply to an inquiry by Dr. Stephens concerning the cost of the splints, said that when they were given the plaster cast to work on, the splint makers at the hospital splint shop were able to complete them for about four guineas each.

(To be continued.)

Naval, Military and Air Force.

APPOINTMENTS.

THE undermentioned appointments, changes *et cetera* have been promulgated in the *Commonwealth of Australia Gazette*, Number 167, of August 21, 1941.

CITIZEN NAVAL FORCES OF THE COMMONWEALTH.

Royal Australian Naval Reserve.

Appointment.—Norman Lennox Speirs is appointed Surgeon Lieutenant, dated 1st August, 1941.

AUSTRALIAN IMPERIAL FORCE.

Australian Army Medical Corps.

Captain H. G. Prest is transferred from "Voyage Only" duties with regimental seniority next after Captain C. R. B. Richards, 16th June, 1941 (in lieu of the notification respecting this officer which appeared in Executive Minute No. 127/1941, promulgated in *Commonwealth Gazette* No. 140, of 17th July, 1941).

Captain W. G. Holt is transferred to the Regimental Supernumerary List, 11th June, 1941.

To be Lieutenant-Colonel.—Captain (Temporary Major) G. R. Troup, 1st July, 1941.

To be Majors.—Captain (Temporary Major) J. F. Dunkley, Captain J. E. P. Hogg, Honorary Captain A. C. McEachern and Andrew Alexander Sharland, 1st July, 1941.

To be Captains.—Captain E. A. F. McDonald, Honorary Captains R. V. Richard and F. P. G. Smith, 1st July, 1941; and T. Le G. Brereton, 15th July, 1941.

To be Captains.—Captains R. DeG. Burnard, 1st July, 1941; and J. B. Oakeshott, 21st July, 1941; Honorary Captains D. O. Crompton, J. L. Dunstone, H. J. Edelman and P. Kaye and Robert Kiel, 1st July, 1941.

The appointment of Lieutenant-Colonel V. M. Copleston is terminated, 24th June, 1941.

Captain T. B. C. Patrick is transferred from Reinforcements, 1st July, 1941.

Captain W. Freeborn, M.M., is transferred to Reinforcements, 1st July, 1941.

The notification respecting Captain W. Freeborn, M.M. which appeared in Executive Minute No. 127/1941, promulgated in *Commonwealth Gazette* No. 140 of 17th July, 1941, is withdrawn.

Captain L. P. Sapsford is transferred to the Regimental Supernumerary List, 24th June, 1941.

Permanent Supernumerary List.

Captain J. Reid is transferred from Australian Army Medical Corps, 9th June, 1941.—(Ex. Min. No. 144—Approved 14th August, 1941.)

AUSTRALIAN MILITARY FORCES. AUSTRALIAN ARMY MEDICAL CORPS.

Seventh Military District.

Captain (provisionally) (now Temporary Major) V. J. McGovern is transferred from Australian Army Medical Corps, 2nd Military District, 1st March, 1941.

Captain (Temporary Major) H. R. Pomroy is transferred from Australian Army Medical Corps, 4th Military District, and retains the temporary rank of Major, 26th April, 1941.

To be Lieutenant-Colonel (temporarily).—Captain (Temporary Major) H. R. Pomroy, 3rd June, 1941.

Northern Command.

First Military District.

The following officers are appointed from the Reserve of Officers (A.A.M.C.) on the dates shown and to be Captains (provisionally): Honorary Captains E. A. F. McDonald, H. K. Denham, A. J. G. Nicholson and J. H. Simmonds, 14th June, 1941; and G. A. McLean, 7th July, 1941.

The appointments of Captain (Honorary Major) N. G. Sutton and Captain H. W. Savage are terminated, 15th November, 1940.

To be Honorary Majors.—Captains S. Julius and D. H. K. Lee, 7th July, 1941.

To be Honorary Captain.—William Dunham Exton, 14th July, 1941.

The following officers are appointed from the Reserve of Officers (A.A.M.C.) on the dates shown and to be Captains (provisionally): Honorary Captains J. A. L. Atkinson, with regimental seniority next after Captain (provisionally) P. J. Monahan, 29th May, 1941, J. R. Hutcheon, 9th June, 1941, T. M. Mansfield, 14th June, 1941, H. G. Wilson with regimental seniority next before Captain (provisionally) E. A. F. McDonald, 14th June, 1941, R. V. Rickard, 30th June, 1941, and R. A. G. Malcolm with regimental seniority next after Captain (provisionally) J. H. Simmonds, 3rd July, 1941.

To be Captain (provisionally).—Thomas Keith Wilson, 21st July, 1941.

Eastern Command.

Second Military District.

Honorary Captain T. Le G. Brereton is appointed from the Reserve of Officers (A.A.M.C.), 14th July, 1941.

To be Captain (provisionally).—Andrew Alexander Sharland, 30th June, 1941.

To be Honorary Captains.—Ronald Cedric Sork, Henry Allen Annetta, 10th July, 1941, and Gladstone Russell Gillies, 11th July, 1941.

The following officers are appointed from the Reserve of Officers (A.A.M.C.) and to be Captains (provisionally): Honorary Captains N78589 F. G. Meyer, 26th August, 1940 (in lieu of the notification respecting this officer which appeared in Executive Minute No. 15/1941, promulgated in *Commonwealth Gazette*, No. 20 of 1941), and R. G. V. Parker, 19th June, 1941, and R. S. Stafford, 8th July, 1941.

The provisional appointment of Captain N27260 G. S. Flynn is confirmed.

To be Captain (provisionally).—Eric Ambrose Claude Marshman, 14th July, 1941.

To be Honorary Captains.—Phillip Vernon Dixon, Raymond Jesse Alsopp and John McKee, 18th July, 1941.

Southern Command.

Third Military District.

To be Captains (provisionally).—Keith Macrae Bowden, 30th June, 1941; and Arthur Russell Hughes, 16th July, 1941.

To be Honorary Captains.—Laurance Seymour Horton and Leslie Charles Hudson, 9th July, 1941, and George William Patterson and John Westlake Wales, 16th July, 1941.

Fourth Military District.

To be Major (temporarily).—Captain S30561 A. W. S. J. Welch, 16th July, 1941.

The resignation of Honorary Captain H. R. P. Boucaut of his commission is accepted, 16th July, 1941.

To be Honorary Captain.—Patricia Lesley Bidstrup, 30th June, 1941.

To be Honorary Captains.—Henry Raymond Russell Hancock and Eugene McLaughlin, 18th July, 1941.

Western Command.

Fifth Military District.

Honorary Captain (Temporary Major) A. R. S. Vickers is appointed from the Reserve of Officers (A.A.M.C.) and to be Captain (provisionally), 30th January, 1940, and to be Major (temporarily), 20th June, 1940.

Captain (provisionally) (Temporary Major) A. R. S. Vickers is appointed to command a General Hospital and is granted the temporary rank of Lieutenant-Colonel, 23th June, 1941.

Major (provisionally) C. H. Leedman, M.C., is appointed to command a Casualty Clearing Station and is granted the temporary rank of Lieutenant-Colonel, 3rd July, 1941.

ROYAL AUSTRALIAN AIR FORCE.

Citizen Air Force: Medical Branch.

Flight Lieutenant K. A. McLean is promoted to Temporary Squadron Leader, with effect from 9th May, 1941.

The following is appointed to commissions on probation, with the rank of Flight Lieutenant, with effect from the date indicated: John Thomson Gunther, M.B., 30th June, 1941.—(Ex. Min. No. 120—Approved 20th August, 1941.)

The probationary appointments of the following officers are confirmed: Temporary Squadron Leaders C. Craig, R. McM. Glynn, I. B. Jose, R. J. Wright-Smith, A. L. Tostevin, L. E. Hurley, J. O'Sullivan, H. W. Savage, N. G. Sutton, C. H. C. Searby, A. T. Roberts, J. H. B. Brown, H. G. Allen, A. J. H. Stobo, G. E. Phillips; Flight Lieutenants D. B. Skewes, C. G. Davidson, W. M. Lemmon, E. J. Davies, V. S. Howarth (Acting Squadron Leader) J. C. Sangster, D. T. Shortridge, W. Deane-Butcher, A. J. Harker, B. J. Basil-Jones, J. C. A. Dent, C. A. Frew, F. V. Munro, (Acting Squadron Leader) F. G. Steele, H. Whitaker, T. H. Donnelly, J. M. Alexander, L. T. Conlon, W. T. Coyle, K. H. Hill, J. Isbister, M. Morris, A. T. Pearson, S. M. L. Dunstone, D. C. Traitor, A. C. Blumer, G. J. B. Baldwin, S. W. Dobell-Brown, W. H. Fraser, A. G. McManis, V. R. Meek, R. J. Riddell, R. G. Tonkin, F. R. Wicks, S. Thomson, R. C. Gill, B. Epstein, B. W. Monahan, J. S. Robertson, H. A. A. Aitmann, J. H. Deakin, W. B. Marsh, R. G. Mackay, W. P. McLaughlin, G. L. Young, D. Barry, R. Lloyd-Jones, D. P. Sapsford, E. G. Strahan, A. W. Bayley, A. J. W. Ahern, K. S. Harrison, O. W. Leitch, N. L. Newman, H. M. Webber, S. F. McR. Yeates, B. G. Broadbent, R. G. Harvey, (Acting Squadron Leader) K. K. Stringer, J. Wainwright, E. Campbell, (Acting Squadron Leader) J. J. Arnold, (Acting Squadron Leader) M. J. H. Hutchison, M. A. Lloyd-Jones, J. H. Lee, E. F. Marks, L. G. Moffatt, T. M. D'Olivey, T. B. Lindsay, J. D. Holmes, R. A. W. Snow, S. W. Thomson, C. E. M. Anderson.

The following are appointed to commissions on probation with the rank of Flight Lieutenant with effect from the dates indicated: Francis James Bain Drake, M.B., B.S., George Charles Victor Thompson, M.B., B.S., F.R.C.S., Louis Lancelot Oxley Bevan, M.B., B.S., 14th July, 1941; Geoffrey Charles Corlis, M.B., B.S., Trevor William Jenkins, M.B., B.S., D.T.M., Eric Francis Langley, M.B., B.S., F.R.C.S., Norman William Martin, M.B., Ch.B., Max Anthony O'Halloran, M.B., B.S., 28th July, 1941.

The following Flight Lieutenants are transferred from the Reserve to the Active List with effect from 28th July, 1941: R. G. Baker, H. E. W. Lyons, D. H. LeMessurier, C. W. Allen.

NATIONAL SECURITY (MEDICAL CO-ORDINATION) REGULATIONS.

The following regulations, which have been made under the *National Security Act 1939-1940*, were notified in the *Commonwealth of Australia Gazette*, Number 163, of August 15, 1941.

AMENDMENT OF NATIONAL SECURITY (MEDICAL CO-ORDINATION AND EQUIPMENT) REGULATIONS.

After regulation 4 of the National Security (Medical Co-ordination and Equipment) Regulations the following regulation is inserted:

"4A.—(1.) Notwithstanding anything contained in section 60 of the *Defence Act 1903-1941*, if it appears to the Governor-General to be necessary in the interests of the public safety and the defence of the Commonwealth, he may, by Proclamation, call upon all medical practitioners under sixty years of age (other than medical practitioners employed in the naval, military or air forces of the Commonwealth) irrespective of districts or sub-districts or the classes referred to in that section to serve as medical officers in the Citizen Forces.

(2.) Every medical practitioner called upon in pursuance of this regulation to serve in the Citizen Forces shall, notwithstanding any claim for exemption, attend for medical examination at such times and places as are specified in a notice issued in accordance with this regulation, and shall furnish such information as is required for the purposes of this regulation. Unless he is included in one of the classes of persons specified in sub-regulation (4.) of this regulation,

he may be appointed as a medical officer in any part of the Citizen Forces, and shall, if so appointed, serve within the Commonwealth as a medical officer in that part of those Forces:

Provided that a person called upon in pursuance of this regulation to serve in the Citizen Forces shall not be appointed as a medical officer in the Naval Forces or the Air Force without his consent, but if he so consents and is so appointed, he shall be liable to serve outside the Commonwealth:

Provided further that nothing in this regulation shall prevent any medical practitioner appointed to the Citizen Military Forces from volunteering to serve in any force raised for service outside the Commonwealth.

(3.) A notice for the purposes of this regulation shall be issued by the Chairman of the Central Committee, upon the recommendation of that Committee and shall be delivered by hand to, or posted to the last known place of residence of, the person to whom it relates.

(4.) The following persons shall be exempt from service in the Citizen Forces under this regulation:

- (a) Persons reported by the medical authorities prescribed in pursuance of the *Defence Act 1903-1941* as unfit for any naval, military or air force service whatever;
- (b) Members of the Parliament of the Commonwealth or of a State;
- (c) Persons exempted by the Central Committee in order to provide for the requirements of the civil population.

(5.) Any medical practitioner called upon by a Proclamation issued in pursuance of this regulation to serve in the Citizen Forces may forward an application in writing for exemption to the Chairman of the State Committee in the State in which he resides.

(6.) The Chairman of the State Committee shall transmit the application to the Chairman of the Central Committee, with a recommendation in relation thereto by the State Committee, and the Chairman of the Central Committee shall submit the application to the Central Committee, which may grant or refuse the application.

(7.) Exemptions granted by the Central Committee may be for such periods and subject to such conditions as the Committee determines, and may be revoked by the Committee at any time.

(8.) Where the Central Committee grants exemption to any medical practitioner, the Chairman of the Committee may issue a certificate of exemption to him.

(9.) A person to whom a certificate of exemption has been issued in accordance with this regulation shall—

- (a) produce the certificate on demand by any Commonwealth officer, or any member of the Police Force of the Commonwealth or of a State or Territory of the Commonwealth; and
- (b) upon the revocation of the exemption or the cessation of the condition or status on which the exemption is based, surrender the certificate to the Chairman of the State Committee."

REPORT ON MENINGOCOCCAL MENINGITIS.

THE Director-General of Medical Services has forwarded for publication the following report on twenty-nine cases of meningococcal meningitis in which treatment was carried out at the First Australian General Hospital. The report, which has been compiled by Major Lorimer Dods, officer in charge of the isolation division of the hospital, is as follows.

INTRODUCTION.

Between 4 Dec. 1940 and 18 April 1941 twenty-nine (29) cases of Meningococcal Meningitis were admitted to the Isolation Division of 1st Australian General Hospital.

The early cases (admitted during December, January and February) were all of the fulminating type; the majority were unconscious and intensely irritable on admission and three of them remained in this state for several days. Three of these soldiers exhibited well marked petechial and purpuric rashes and one of them presented the signs of a hemiplegia.

The later cases (admitted during March and April) were less fulminating in onset and milder in type.

There were no deaths, and apart from some slight impairment of mental activity in two cases, no obvious sequelae.

TREATMENT.

The following notes about treatment are based on our experience in the management of this series of cases.

Lumbar Puncture.

An initial diagnostic lumbar puncture was carried out in every case, further lumbar punctures were not performed unless there were adequate clinical indications.

Sedation.

The methods of sedation included morphia by hypodermic injection, ether anaesthesia, paraldehyde per rectum or by gavage, phenobarbital, bromides and chloral hydrate. Morphia hypodermically followed by rectal paraldehyde proved a most satisfactory sequence.

As an example of the amount of sedation necessary in the more severe cases: one unconscious and irritable patient was given during his first 48 hours in hospital, 2 open ether anaesthetics, a total of 2½ grains of morphia hypodermically and a total of 16 drachms of paraldehyde per rectum. It would seem that some form of repeated or continuous intravenous sedation might be of great value in the management of cases of this type.

Fluid Intake.

Approximate fluid balance charts were recorded for each patient and, thanks to the enthusiastic perseverance of the nursing staff, an average daily intake of more than five pints was achieved in the majority of these cases.

The unduly drowsy or unconscious patients were given continuous intravenous infusions of 5% dextrose in saline, while necessary.

Fluid was also given by stomach tube to those patients whose sulphapyridine was administered in this way.

Serum.

Polyvalent anti-meningococcal serum was given intravenously (a single dose of 75-100 cc.) to three patients who were unconscious and gravely ill on admission.

No serum was given to the other 26 patients.

Chemotherapy.

All cases were treated with sulphapyridine in the form of "M & B 693" or "Dagenan Soluble".

For the more severe cases of this series the dosage scheme for oral administration was approximately as follows:

Twenty-four Hour Period.	Sulphapyridine (Oral). (Grammes.)	Total Sulphapyridine for Twenty-four Hours. (Grammes.)	Approximate Amount of Sulphapyridine in Grains per Pound of Body Weight per Twenty-four Hours (for 11-stone man).
First ..	4.0 statim. 4.0 in 2 hours. 2.0 4-hourly.	18.0	1.7
Second ..	2.0 4-hourly.	12.0	1.0
Third ..	2.0 to 1.0 4-hourly.	12.0 to 6.0	
Fourth ..	1.0 4-hourly.	6.0	0.5
Fifth ..	1.0 8-hourly.	3.0	
Sixth ..	1.0 8-hourly.	3.0	
Seventh and eighth ..	0.5 8-hourly.	1.5	
Ninth ..	0.5 12-hourly.	1.0	

The total dosage varied from a 6 or 7 days course of 35 grammes in the mildest cases to a 12 days course of more than 80 grammes in the most severe case of the series.

This dosage scheme for the more severe cases might be regarded by some authorities as unduly generous; it was adopted because: (a) most of the cases were of the fulminating type and gravely ill. (b) There were no available standards of adequate dosage levels for this particular local epidemic. (c) Estimations of blood and cerebro-spinal fluid sulphapyridine levels were not feasible.

Administration of Sulphapyridine.

A. Oral.—The tablets of "M & B 693" were crushed and given with alkalis in milk or other fluids, in honey or jam or as a "paste".

In order to economise in the use of "Dagenan Soluble" (the supplies of this preparation being extremely limited) "M & B 693" was given by gavage on a number of occasions to unconscious or unduly drowsy patients of this series. For the deeply unconscious patient the ideal arrangement was a soft rubber tube of small calibre which was left in situ with its end occluded and strapped to the patient's cheek; through this both fluids and "M & B 693" were given by the nurse. When the patient would not tolerate this tube, an ordinary stomach tube was passed at intervals of 4 to 12 hours.

During the early weeks of the epidemic sulphapyridine was occasionally given per rectum (three times the appropriate oral dose being suspended in six ounces of water). As the degree of absorption by this route was very doubtful, this procedure was abandoned.

B. Parenteral.—As the supplies of "Dagenan Soluble" were extremely limited, this product was reserved for use in the treatment of the four most severe cases of this series.

(a) Intramuscular "Dagenan Soluble".—"Dagenan Soluble" was given intramuscularly to four patients. One of these patients who received nine intramuscular injections developed a small area of tissue necrosis at the site of one injection.

In an attempt to avoid the risk of tissue necrosis, a separate needle was used for withdrawing the solution from the ampoules, the injection was given deeply into the muscle substance, the needle was washed through with a little saline before withdrawal and care was taken in the selection of new sites for each injection. It was not found necessary to use any local anaesthetic.

This intramuscular route was avoided in the case of one patient who showed signs of peripheral circulatory failure because of the risk of poor absorption and the possible aggravation of the risk of tissue necrosis.

(b) Intravenous "Dagenan Soluble".—"Dagenan Soluble" was given intravenously to three patients. These patients were gravely ill and were receiving a continuous intravenous drip of 10% dextrose in saline; the injections were given slowly into the tubing of the drip apparatus. (Note: The drip infusion was allowed to run at full force for a few minutes while the cannula and vein were carefully inspected for any possible leakage, before injecting the solution into the tubing.)

(c) Intravenous Sulphapyridine in 5% dextrose-saline.—During a short period when the supplies of "Dagenan Soluble" were temporarily exhausted, attempts were made to treat one case with "M & B 693" grammes 2.0, dissolved in one litre of 5% dextrose-saline, as an intravenous infusion. Unfortunately no "M & B 693" powder was available at this time and it was found that the starch and acacia content of the "M & B 693" tablets made them unsuitable for the preparation of an intravenous solution.

It would seem that a continuous intravenous infusion of sulphapyridine in 5% dextrose-saline (grammes 2.0 of sulphapyridine in 1 litre of solution) would be an ideal method of treatment for the unconscious patient in the absence of supplies of "Dagenan Soluble".

III Effects of Chemotherapy.

Vomiting.

Vomiting was an extremely rare occurrence in any of the more severe cases, but proved a minor difficulty in the management of some of the milder cases. It was found that extra sedation (in the form of morphia by hypodermic injection or phenobarbital by mouth) was most valuable in the control of this complication and one grain of phenobarbital was given one hour before each dose of "M & B 693" during the first few days of chemotherapy in many cases.

Hæmaturia.

Two patients developed a mild transient hæmaturia and one patient a more severe hæmaturia associated with oliguria and the presence of a heavy deposit of urinary crystals which, although not identified, may have been acetylated sulphapyridine crystals.

Skin Lesions.

One patient who was taking sulphamillamide in place of sulphapyridine because of hæmaturia, developed an extensive morbilliform rash.

Blood Dyscrasias.

One patient developed an anaemia and leucopenia on the 12th day of his disease, his red cells falling to 2,200,000 and his leucocytes to 2,100 per cubic millimetre; his platelets remained plentiful, his granular cells mature and not grossly depleted in numbers, and his blood picture responded rapidly to blood transfusions and the suspension of chemotherapy.

This patient was gravely ill for the first three weeks of his illness and was given an intensive course of chemotherapy extending over a period of 12 days.

ACKNOWLEDGEMENT.

Any discussion of the management of these cases would be incomplete without some reference to the enthusiastic and invaluable assistance of the nursing staff, Captain Mackenzie, Captain Rose and Captain Maltby, who were responsible for their treatment.

APPENDIX.

Monthly Admission Rate of Cases of Meningococcal Meningitis, 1st Australian General Hospital.

Month.	No. of Cases Admitted.
December, 1940	7
January, 1941	6
February	5
March	7
April	4

RADIOLOGISTS NEEDED FOR THE AUSTRALIAN IMPERIAL FORCE.

We have been asked to announce that a course of training in radiology will be held in Sydney from September 22 to December 14, 1941. The course will be open to medical practitioners who have volunteered or are prepared to volunteer for service with the Australian Imperial Force. Intending candidates are advised to apply to the Deputy Director of Medical Services in the military district in which they reside. A total of eight officers is required.

CASUALTIES.

ACCORDING to the casualty list received on August 28, 1941, Captain D. W. Brummitt, A.A.M.C., of Dulwich, South Australia, is reported wounded in action.

According to the casualty list received on September 1, 1941, Captain G. M. Hone, A.A.M.C., Unley Park, South Australia, is reported wounded in action. Captain F. E. Gallash, A.A.M.C., Nedlands, Western Australia, is now reported prisoner of war.

Correspondence.

MEDICAL SOCIOLOGY.

SIR: I was most interested in the articles by Dr. John Dale and Dr. Maller on sociology and medicine. The relation of poverty to disease, especially amongst children, is a problem even in a prosperous country town such as Armidale, where the children can all enjoy plenty of sunshine and fresh air and have ample playing areas. Last month there were twelve patients in the children's ward at our hospital, and I investigated their sociological status. These children were all suffering from medical diseases, such as bronchitis, bronchopneumonia, nephritis, otitis media, malnutrition and pericarditis. Only one child had a father who was keeping his family in reasonable comfort. Three babies were half-caste aboriginals (woefully underfed), the fathers of three children had deserted their families, one father was in prison, two were either on the dole or did relief work, and two children were illegitimate. This might have been an especially unfortunate week, but we notice year after year how children from these types of families fill our wards, and the same children are readmitted again and again. Surely the first line of attack needed to create a healthy nation is to see to it that the children are adequately fed.

Other speakers in the discussion on the papers mentioned the problem of the unskilled worker, the man who can do anything, which means that he can do nothing properly. We have a shelter in Armidale for men on the track. Last year 800 men passed through this shelter, and only 2% were skilled tradesmen. This is an indication that lack of training causes unemployment, poverty, and eventually crime. The health of our people bears a definite relation to their economic position, and it is cheering to see that a number of the members of our profession are stressing that fact.

Yours, etc.,

ELLEN M. KENT HUGHES.

Armidale,
New South Wales,
August 18, 1941.

Australian Medical Board Proceedings.

QUEENSLAND.

THE undermentioned have been registered, pursuant to the provisions of *The Medical Act, 1939*, of Queensland, as duly qualified medical practitioners:

Hynes, James Vincent, M.B., B.S., 1941 (Univ. Queensland), General Hospital, Brisbane.
MacLurkin, Alfred Robert, M.B., Ch.B., 1900 (Univ. Glasgow), Cooktown.
Reeves, Thomas Conrad, M.R.C.S. (England), L.R.C.P. (London), 1911, Quay Street, Bundaberg.

Obituary.

ALFRED SHEPPARD GRIMWADE.

WE regret to announce the death of Dr. Alfred Sheppard Grimwade, which occurred on August 26, 1941, at Geelong, Victoria.

EDWIN WALTER FITZPATRICK.

WE regret to announce the death of Dr. Edwin Walter Fitzpatrick, which occurred on August 30, 1941, at Sydney, New South Wales.

MEDICAL WAR RELIEF FUND.

THE following is a fifteenth list of contributions to the Medical War Relief Fund established by the Federal Council of the British Medical Association in Australia for the relief of distressed medical practitioners in Great Britain.

Western Australia.

£1 1s.: Dr. R. C. Fairbairn, Dr. A. Daly Smith.

Medical Appointments.

Dr. Emanuel Sydney Morris has been appointed Inspector-General of the Insane for the purposes of the *Lunacy Act of 1893*, of New South Wales.

Dr. Grey Lamont Ewan has been appointed Director of the Division of Mental Hygiene, Deputy Inspector-General of Mental Hospitals, Department of Public Health, New South Wales, and Deputy Inspector-General of the Insane for the purposes of the *Lunacy Act of 1893*, of New South Wales.

Books Received.

"The Science and Practice of Surgery", by W. H. C. Romanis, M.Ch., F.R.C.S., F.R.S., and P. H. Mitchiner, C.B.E., M.S., F.R.C.S.; Volume I: General Surgery; Volume II: Regional Surgery; Seventh Edition; 1941. London: J. and A. Churchill Limited. Crown 4to, pp. 905 (Volume I) and pp. 1067 (Volume II), with 810 illustrations. Price: 15s. net each volume.

"Surgery of the Heart", by E. S. J. King, M.D., M.S., D.Sc., F.R.C.S., F.R.A.C.S.; 1941. London: Edward Arnold and Company. Medium 8vo, pp. 740, with illustrations. Price: 50s. net.

"Textbook of Gynaecology", by W. Shaw, M.A., M.D., F.R.C.S., F.R.C.O.G.; Third Edition; 1941. London: J. and A. Churchill Limited. Medium 8vo, pp. 624, with 4 colour plates and 255 illustrations. Price: 21s. net.

"Medical Organisation and Surgical Practice in Air Raids", by P. H. Mitchiner, C.B.E., T.D., D.L., M.D., M.S., F.R.C.S., and E. M. Cowell, C.B., C.B.E., D.S.O., T.D., D.L., M.D., B.S., F.R.C.S., with a foreword by Sir Cuthbert Wallace, Bt., K.C.M.G., C.B., F.R.C.S.; Second Edition; 1941. London: J. and A. Churchill Limited. Large crown 8vo, pp. 305, with 1 colour plate and 58 illustrations. Price: 12s. 6d. net.

"Diseases Transmitted from Animals to Man", by T. G. Hull, Ph.D.; Second Edition; 1941. Springfield: Charles C. Thomas. Royal 8vo, pp. 416, with illustrations. Price: \$5.50 net.

"Lectures on War Neuroses", by T. A. Ross, M.D., F.R.C.P.; 1941. London: Edward Arnold and Company. Crown 8vo, pp. 123. Price: 6s. net.

"Human Physiology", by A. A. Abbie, M.D., D.Sc., Ph.D.; 1941. Sydney: Angus and Robertson Limited. Crown 8vo, pp. 336, with 74 illustrations. Price: 6s. net.

"Abdominal Operations", by R. Maingot, F.R.C.S.; two volumes; 1940. New York: D. Appleton-Century Company Incorporated; Sydney: Angus and Robertson Limited. Super royal 8vo, pp. 813 (Volume I) and pp. 578 (Volume II), with illustrations. Price: 90s. net.

Diary for the Month.

SEPT. 9.—New South Wales Branch, B.M.A.: Executive and Finance Committee.

SEPT. 9.—Tasmanian Branch, B.M.A.: Branch.

SEPT. 11.—Victorian Branch, B.M.A.: Ethics Subcommittee.

SEPT. 12.—Queensland Branch, B.M.A.: Council.

SEPT. 15.—Victorian Branch, B.M.A.: Hospital Subcommittee.

SEPT. 16.—New South Wales Branch, B.M.A.: Ethics Committee.

SEPT. 16.—Victorian Branch, B.M.A.: Organization Subcommittee.

SEPT. 16.—Victorian Branch, B.M.A.: Finance, House and Library Committee.

SEPT. 17.—Western Australian Branch, B.M.A.: Branch.

SEPT. 18.—New South Wales Branch, B.M.A.: Clinical.

SEPT. 18.—Victorian Branch, B.M.A.: Executive.

SEPT. 23.—New South Wales Branch, B.M.A.: Medical Politics Committee.

Medical Appointments: Important Notice.

MEDICAL PRACTITIONERS are requested not to apply for any appointment mentioned below without having first communicated with the Honorary Secretary of the Branch concerned, or with the Medical Secretary of the British Medical Association, Tavistock Square, London, W.C.1.

New South Wales Branch (Honorary Secretary, 135, Macquarie Street, Sydney): Australian Natives' Association; Ashfield and District United Friendly Societies' Dispensary; Balmmain United Friendly Societies' Dispensary; Leichhardt and Petersham United Friendly Societies' Dispensary; Manchester Unity Medical and Dispensing Institute, Oxford Street, Sydney; North Sydney Friendly Societies' Dispensary Limited; People's Prudential Assurance Company Limited; Phoenix Mutual Provident Society.

Victorian Branch (Honorary Secretary, Medical Society Hall, East Melbourne): Associated Medical Services Limited; all Institutes or Medical Dispensaries; Australian Prudential Association, Proprietary, Limited; Federated Mutual Medical Benefit Society; Mutual National Provident Club; National Provident Association; Hospital or other appointments outside Victoria.

Queensland Branch (Honorary Secretary, B.M.A. House, 225, Wickham Terrace, Brisbane, B.17): Brisbane Associated Friendly Societies' Medical Institute; Bundaberg Medical Institute. Members accepting LODGE appointments and those desiring to accept appointments to any COUNTRY HOSPITAL or position outside Australia are advised, in their own interests, to submit a copy of their Agreement to the Council before signing.

South Australian Branch (Honorary Secretary, 178, North Terrace, Adelaide): All Lodge appointments in South Australia; all Contract Practice appointments in South Australia.

Western Australian Branch (Honorary Secretary, 205, Saint George's Terrace, Perth): Wiluna Hospital; all Contract Practice appointments in Western Australia.

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